THE REALIST

A MONTHLY JOURNAL

SCIENCE · INDUSTRY · ART · ECONOMICS

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THE REALIST

A JOURNAL OF SCIENTIFIC HUMANISM

VOL. I No. 4

CONTENTS FOR JULY 1929

		PAGE
THE NON-MUSICAL SIDE OF OPERA	*Arnold Bennett*	3
THE SCIENTIFIC POINT OF VIEW	*J. B. S. Haldane*	10
DOSTOEVSKI AND PARRICIDE	*Dr. Siegmund Freud*	18
THE FUTURE OF THE EARTH	*Harold Jeffreys*	34
THE OVER-PRODUCTION OF FOOD	*R. A. Fisher*	45
A DYNAMIC TECHNICAL MUSEUM	*Waldemar Kaempffert*	61
THE SOCIAL LIFE OF THE PRIMATES	*S. Zuckerman*	72
L'HOMME MACHINE	*E. B. Strauss*	89
PHILOSOPHY AND ALDOUS HUXLEY	*C. E. M. Joad*	99
RUSSIA AND EUROPEAN CIVILISATION	*A. Lobanov-Rostovsky*	115
"REPRESENTATION" IN MUSIC	*Ernest Newman*	127
COLOUR MUSIC	*Vernon J. Clancey*	138
"THE REALIST" BOARD SURVEYS CURRENT EVENTS		148
NOTES ON CONTRIBUTORS		152

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JULY 1929 No. 4

The Non-musical Side of Opera

ARNOLD BENNETT

FOR forty years I have been an ardent and arduous opera-goer, and I have witnessed grand opera in probably forty cities of Europe and America. Sometimes it occurs to me to examine realistically the debit side of the endless enterprise.

For example, to-day in London. London is the only European city where the managers of opera absolutely insist upon evening-dress being worn in the best seats for any performance beginning after 5 p.m. If a performance begins at 7 p.m.—and few of the finest performances begin later—you must have changed your clothes by 6 p.m., to the detriment of your afternoon's work. Then you must immediately eat, for though it is impossible to be hungry at 6 p.m. it is equally impossible to sit through four hours (and a few odd minutes) of music without some previous fortification of the alimentary tract. The choice of the meal—which is a passover, consumed in haste and probably on foot—presents a problem which nobody has yet satisfactorily solved. At best the nameless repast startles and deranges the conservative stomach, which reproaches and even nags the mind, heart, and soul more or less continuously until the next morning. Having frigidly flirted with the meal, your eye ever on the clock, you issue forth in evening-dress into full daylight. The daylight puts you to shame, if you are capable of shame. To come home in evening-dress at 6 a.m. proves to milkmen that at any rate you have lived gloriously. To leave home at 6.30 p.m. in evening-dress in daylight merely makes you feel like a fool in fancy costume.

You start very early on your journey because you are a devotee. But you have not got far before you realise that you have not started early enough. The whole traffic of London seems to have joined a conspiracy to impede your progress. When you are within five minutes walking distance of the opera-house you are invariably halted at cross-roads. The policeman who rules over those cross-roads with a rigour unmatched in any transalpine régime, is the impassioned representative of an inartistic democracy. He distinguishes not between motor-cars, lorries, buses, and handcarts. It is naught to him that you are engaged in the patriotic task of demonstrating that England is a musical nation. You wait. And you wait. You move on ten yards and you wait. By supraconscious or subconscious tension of the muscles you strive to push forward your vehicle, which will not budge. At length you find yourself in a narrow street encumbered exclusively by the vehicles of those who are engaged in the patriotic enterprise of demonstrating that England is a musical nation. The salt of the earth, the enlightened, the refined ! But no amount of culture can communicate alacrity to your vehicle. You think of short cuts. The police forbid them. You are inextricably part of a procession which a procession of mourning coaches would leave standing. You wait and wait. You enter a narrow defile. You wait. The clock of your vehicle has taken advantage of your momentary inattention to slip past seven o'clock.

You jump quickly out of the vehicle, but not quickly enough for the impatience of the functionary in command of the situation. He waves your vehicle away from under your very feet. You find the priceless tickets to obtain which you have had to practise a devious chicane. You cross the foyer.

" Curtain up ? "

" Just going up, sir," says the ticket-taker laconically.

You are in darkness. But an attendant emerges, a ghost out of the darkness, aims the ray of an electric torch at you, at your ticket, and at the floor. The ray flashes around like the revolving beam of a lighthouse. A hoarse whisper guides you. You subside stumbling into your hard seat, and give a sigh. You hear in the distance well-known phrases of music. And of course by this time you are in just the right calm, receptive condition, mental and spiritual, for listening to these now classic phrases !

But you are not the last person to be late. There is a continu-

ous invasion of later persons, who must exchange hoarse whispers with an attendant whom heaven has not endowed with the obviously necessary gift of being in two places at once. These self-absorbed persons are continuously brushing by you, over you, in front of you, behind you. Many of them pass up the long central aisle like warning shadows, presently silhouetted against the light of the stage—for the curtain is now lifted. The invasion is maintained, the torch is incessantly flashed, the whispering is heard, for half an hour (by the luminous watch), and after it has in fact finished you exist for a few minutes in the apprehension that it is not finished. The act is rather more than half over.

In finer condition than ever for receiving the spiritual and æsthetic rewards of your enterprise you bestow a reverent attention upon the stage. Now the opera is gigantic, the stage is gigantic, and the central figure (with most of the other figures) is gigantic. The central figure is a tremendous girl, with tremendous blonde hair, and clad in a monstrous, silken peignoir. The whole point of the first act is that she is a virgin unused to the world, and incapable of travelling alone. But by tradition she has none of the characteristics of a virgin. She moves about with the assurance of a society woman of fifty. She can and easily does talk—I should say sing—the other figures down. She is desirous of committing murder, and she makes every preparation for so doing. She is a princess going by sea to meet her future husband, a king.

The ship in which she voyages has the dimensions of an Aquitania. Everything about it is terrific—except the running-gear, which would hardly be adequate for a ten-ton yacht. A part of its main deck is furnished like a throne-room. Its furniture includes gold plate so slenderly based that it could not be used on an Aquitania because the least rolling of the ship would upset it. But this nordic or celtic liner, though sailing in a fresh wind, has no tremor. Forward of the throne-room gigantic curtains, which screen it from the forecastle when the passengers feel the need of privacy, never belly either inward or outward in the fresh wind—so massive and weighty is the stuff of them. Yet a lady's-maid can and does shift them to and fro as easily as if they were of muslin. True, she is gigantic.

When the curtains are apart you can witness that the ship is sailing on an ocean out of sight of land. Then there is loud shouting and song, from which you learn that the ship is near to

port. The curtains, which have been closed, are drawn apart again. You see and hear the members of the crew hailing the people on land. They have tremendous voices, but surely not quite tremendous enough for the situation ; for there is no sign of a shore on the horizon, and the haven must be still at least fifteen miles off. The act ends on this climax.

You are allowed twenty-five minutes in which to wander up stairs blocked with ladies engaged in telling one another how sublime the general affair is, and how super-sublime is one of the singers, and how inferior is another, and to force your way through doorways blocked by ladies similarly engaged. You see a food and drink counter for which your alimentary tract has begun to yearn, but in addition to being a counter it is the field of a battle of starving desperadoes, and, being unarmed, you prudently do not approach it.

The second act is a garden in which a long love scene occurs between the princess, now a queen and an adulteress, and her paramour. The music of this scene counts among the most lovely in the annals of opera, and in order to help you to concentrate your whole soul upon it, a moonlit stream runs down in everlasting repetition towards the front of the stage. The author-composer of the opera says nothing about the stream in his published stage-directions ; but it gives a wonderful imitation of a real moonlit stream, and at moments when the complexity and grandeur of the music become too much for you, you can take ease therefrom by watching with what precision and with what regular periodicity the light of the unseen moon glints on one self-same stone—or it may be on water purling over the self-same stone. Towards the close of the act the king dramatically appears. A few weeks of wedlock with the tremendous girl have aged him into the senile. He can hardly stand up. But he has supporters, and one of them in one second mortally wounds the hero, and the curtain descends on the hero's recumbent body.

Another interval like the first, but shorter. It would be otiose to describe the third act. Let me say only that the tremendous girl supervenes and sings gloriously and at great length and amid a scene of ruin and death. On the final fall of the curtain, loyal to the last, you stay and applaud enthusiastically. You leave the auditorium. You try to force a path through the doorways into the street, but you cannot, for they are blocked by ladies as stalwart as the erring queen

herself. When you do get out you go running about in the rain to find your vehicle. You find a thousand vehicles, but not your own. You can obtain no help. Everything, however, comes to him who knows how to wait, and you are by this time a finished expert in waiting. At last you reach home, weary, exhausted, a broken man, too enfeebled even to eat. The next morning, after a highly disturbed and unsatisfactory night, and with the prospect of a sterile day, you are liable to read in the newspapers that you have listened to one of the greatest performances ever given of one of the greatest operas ever written. And no doubt you have.

No one, I think, will say that I have given an unfair account of what it is to attend a first-class performance of opera in London. Some no doubt will assert that my description is frivolous, and that it omits all reference to the musical side of the grandiose phenomenon: which side is the principal side. I agree that the musical side is the principal side. But I deny the frivolity and maintain that the non-musical side has very important and destructive reactions on the enjoyment of the musical side. I would be inclined to say: fatal reactions. I would say positively that a presentation of opera in which the creative effort is confined to the musical side, neglecting the other side, is an ill-balanced presentation and in the total result a bad one, however fine the achievement on the musical side may be. I admire the effort. I would not belittle it. I would not blame anybody. But I can see nothing but good as a consequence of looking all the facts in the face. And I have a conviction that the non-musical side is capable of amelioration without excessive cost.

The traffic arrangements which must, and notoriously do, lessen the æsthetic pleasure derived from the spectacle, appear to me to be crude and capricious, and susceptible of improvement—in consultation with the police. The eating and drinking arrangements would be regarded as unworthy of the organisers of a school-treat. The managerial rule against morning-dress is in the view of many frequenters an ignoble concession to the snobbishness of a few, and is the less defensible seeing that the performances take place in the dark.

If the rule against morning-dress were relaxed and a new rule made that late-comers must wait in the foyer (thus incidentally regaining their tranquillity) until the end of the act in progress, it would be obeyed and enjoyment would be promoted.

In various continental opera-houses such a rule obtains, and is resented, if at all, only by British tourists. Unpunctuality is egotistic and one of the worst forms of rudeness; it implies a grave lack of the social sense. Women are the cause of nine-tenths of all unpunctuality everywhere.

Again, a notice might be posted in the foyer and corridors: "The management respectfully requests ladies not to obstruct stairways and doorways, which are intended to facilitate movement and not argument."

To come to the stage. Is it right, decent, and unridiculous that beautiful music should be set off with ugly costumes and ugly scenery? Apart from performances of the Russian ballet, I have never in forty years seen scenery at Covent Garden that was not perfectly grotesque in its ugliness, nor groups of artists the majority of whose costumes were not an outrage to the educated eye. The frocks which some of the sopranos and contraltos are forced to wear fill one with compassion for the unhappy wearers. They are miracles of disfiguring inelegance. And there is no reason nor excuse for them.

As for the scenery, it is as evil, æsthetically, as the costumes. Worse, it is absurd. The convention of the theatre is necessarily absurd. The convention of opera is necessarily still more absurd, judged by any standard of persuasive realism. People don't sing to one another their loves and hates and wrongs and ecstasies. Nor does it help that, in no matter what language they are sung, fifty per cent. of the words are incomprehensible even to those familiar with the language. All this is unavoidable. It is part of the price which has to be paid for the enjoyment of music. But ugliness in any form need be no part of the price.

Scenery involves outlay. But scenery must be renewed from time to time. The trouble is that the renewals are just as ugly as the scrapped, and not seldom uglier. The pictorial ideals which survive in opera-houses have been completely unaffected by the artistic renascence which has triumphed outside opera-houses.

Nor is it part of the price to be paid for musical enjoyment that scenery, by preposterously defying commonsense, should add to the unconvincingness of the operatic convention. For instance, in the ship-scene which I have partially described, there is no conceivable reason why the furniture should not have marine characteristics, why the gear should not resemble gear, and why towards the end of the act a back-cloth representing a

port should not be substituted, during a period of closed curtains, for a back-cloth representing the high seas. Dozens of other instances might be adduced.

To argue that such material changes would not increase the æsthetic pleasure of the audience shows an incapacity to assess the interactions between the audience and the stage. The purpose of the music is to raise realism to the sublime. The purpose of the scenery seems to be to degrade it to the ridiculous. The composer desires before everything to produce in the audience the illusion that what happens on the stage did really happen. But in a hundred small ways scenery and costume are apparently designed to make the secretly restive audience say in its heart : " The thing couldn't really have happened like that, and it didn't."

I am honestly grateful to the Covent Garden authorities for what they have accomplished in the splendidly hopeless attempt to keep satisfactorily alive unsubsidised grand opera. But they might, I think, do a little bit more without inviting financial disaster. And I am the more surprised that they leave undone the little bit because the " big " répertoire is so limited. Only seven operas, six by one composer and one by another, can be relied upon to fill the house at " big " prices. These operas are repeated again and again in the season, and year after year. Hence there should be fair opportunity for small improvements. Further, as the stalls alone are reputed to hold £1,000 a night, there should be a few score pounds available to pay for those improvements.

The Scientific Point of View

J. B. S. Haldane

SCIENCE affects the average man and woman in two ways already. He or she benefits by its applications, driving in a motor-car or omnibus instead of a horse-drawn vehicle, being treated for disease by a doctor or surgeon rather than a priest or a witch, and being killed with an automatic pistol or a shell in place of a dagger or a battle-axe. It also affects his or her opinions. Almost everyone believes that the earth is round and the heavens nearly empty, instead of solid. And we are beginning to believe in our animal ancestry and the possibility of vast improvements in human nature by biological methods.

But science can do something far bigger for the human mind than the substitution of one set of beliefs for another, or the inculcation of scepticism regarding accepted opinions. It can gradually spread among humanity as a whole the point of view that prevails among research workers, and has enabled a few thousand men and a few dozen women to create the science on which modern civilisation rests. For if we are to control our own and one another's actions as we are learning to control nature, the scientific point of view must come out of the laboratory and be applied to the events of daily life. It is foolish to think that the outlook which has already revolutionised industry, agriculture, war, and medicine, will prove useless when applied to the family, the nation, or the human race.

Unfortunately, the growing realisation of this fact is opening the door to innumerable false prophets who are advertising their own pet theories in sociology as scientific. Science is continually telling us through their mouths that we are doomed unless we give up smoking, adopt—or abolish—birth control, and so forth. Now it is not my object to support any scientific theory, but merely the scientific standpoint. What are the characteristics of that standpoint ? In the first place, it attempts to be truthful and, therefore, impartial. And it carries impartiality a great deal further than does the legal point of view. A good judge will try to be impartial between Mr. John Smith and Mr. Chang Sing. A good scientist will be impartial between Mr. Smith, a tape-worm, and the solar system. He

will leave behind him his natural repulsion of the tape-worm, which would lead him to throw it away instead of studying it as carefully as a statue or a symphony, and his awe for the solar system, which led his predecessors either to worship its constituents, or at least to regard them as inscrutable servants of the Almighty, too exalted for human comprehension.

Such an attitude leads the scientist to a curious mixture of pride and humility. The solar system turns out to be a group of bodies rather small in comparison with many of their neighbours, and executing their movements according to simple and easily intelligible laws. But he himself is a rather aberrant member of the same order as the monkeys, while his mind is at the mercy of a number of chemical processes in his body which he can understand but little and control hardly at all.

In so far as it places all phenomena on the same emotional level, the scientific point of view may be called the God's eye view. But it differs profoundly from that which religions have attributed to the Almighty in being ethically neutral. Science cannot determine what is right and wrong, and should not try to. It can work out the consequences of various actions, but it cannot pass judgment on them. The bacteriologist can merely point out that pollution of the public water supply is likely to cause as many deaths as letting off a bomb in the public street. But he is no better equipped than anyone else in possession of the knowledge he has gained, for determining whether these two acts are equally wrong. The enemies of science alternately abuse its exponents for being deaf to moral considerations and for interfering in ethical problems which do not concern them. Both of these criticisms cannot be right.

Now the tendency of the average man has always been to dwell on the emotional and ethical side of a case, rather than on facts of the somewhat dull kind which interest the scientist. Let me take two examples, the problem of the American negro, and the problem of disease. A large number of Americans hold that the negro is definitely inferior to the white man, and should, as far as possible, be segregated from him. Others believe that he should enjoy the same rights. The biologist cannot decide between them. He can point out that the negro's skull is more ape-like than the white's, but his hairless skin less so, and so forth. But he can note the results of the two divergent political views as to the negro. In the country districts of the Southern States the birth-rate of the negro

population exceeds the death-rate. In the southern towns, and all through the north, more negroes die than are born. Their high death-rates are due to the fact that, in an environment suitable to a white man, they die of consumption and other diseases, just as the white man dies on the West Coast of Africa, the negro's original home.

So if you keep the negro out of cars, factories, and so forth, or frighten him away from contact with whites by an occasional lynching, you drive him back to the cotton fields where he lives healthily and breeds rapidly, thus creating a negro problem for future generations. But if you extend the hand of fellowship to him you also infect him with your maladies, besides establishing in your midst a reservoir of disease germs.

These results are quite typical of those obtained when our action is guided either by raw emotion or political dogma, rather than scientific thought. The main biological effect of the American civil war was to raise the negroes' death-rate and lower their birth-rate so enormously that it was only between 1910 and 1920 that the number of negroes in the United States increased as much as it had done in the decade before the civil war. The number of negroes thus killed was far greater than the casualty list of the civil war. If to-morrow the coloured population of the Southern states, but not the white, were given free access to cheap whiskey and methods of birth control, the number of negroes would probably begin to fall off! I believe that there are many other political questions, both national and international, whose sting would be removed by a similar consideration of biological facts.

Our approach to the problem of disease is even less rational. I am not thinking of Christian scientists or spiritual healers, but of the average man or woman who has a certain belief in the results of modern medicine, and even of a part of the medical profession itself. Serious illness in ourselves or our friends always rouses a good deal of emotion. Now, when we are emotional about a subject we feel a need to believe something about it, and we do not care very much whether our beliefs are rational. The pre-Christian attitude to disease was that it was a punishment from some deity for a sin either of the sick person, his family, or the whole community. Jesus did not take this view. When asked concerning a man born blind, "Who did sin, this man, or his parents, that he was born blind? . . ." he replied, "Neither hath this man sinned, nor

his parents, but that the works of God should be made manifest in him." This is not so unlike the attitude of the scientist who regards a case of disease as a manifestation of a natural law, which can only be cured or prevented when research has revealed the working of the law in question.

But many religious people still hold to the views which Jesus combated, and those who believe themselves to be more enlightened are often in no better case. Many believe that diseases could be prevented by a return to nature. I suppose that the first step in a return to nature would be the discarding of clothes, which would at once increase the mortality from pneumonia about a hundredfold. Of course, the phrase " Live according to nature" is quite meaningless. Civilised and savage man, health and sickness, are equally parts of nature. Some features of civilisation are bad for health, but for all that, such statistics as are available show that civilised men live longer than uncivilised. The same emotional drive forces people to believe that a cure must be available for most diseases. An acquaintance with the facts of medicine would show them that this is not so. Most disease can be prevented, but when it is there, in nine cases out of ten, the doctor can do very little but prescribe good nursing and rest.

As a matter of fact, the medical situation to-day is very serious. The expectation of life at birth is much the same in most civilised countries, and has risen for the last fifty years.

The greatest causes of this have been the abolition of water-borne diseases such as cholera, and the general prosperity which has nearly banished under-feeding as a cause of ill-health. To-day medical science is still advancing, but it is becoming harder and harder to apply its results in practice.

We know how to prevent infection with syphilis, but law and opinion forbid the spreading of this information, and the attempt to persuade the human race to avoid conduct likely to lead to infection has had little effect on the present generation. So syphilis goes on killing babies and filling asylums. We know how to cure most cases of cancer of the breast. This may seem a startling statement, but the official British medical statistics show that 91 per cent. of the cases of breast cancer, and half of the cases of uterine cancer, operated on at a sufficiently early stage five years ago are still alive and have had no recurrence of the disease. The prospects of radium treatment appear to be better still, but adequate figures are not yet

available. Most of the victims of cancer in these sites die of it, however, because they do not go to the surgeon until they are in serious pain, by which time the cancer has spread and cannot be completely removed. In a series of European cases of uterine cancer the average time between onset of symptoms and consulting the doctor was about eight months. If any newspaper were to publish a daily warning of the early signs of cancer of the womb, it would save many lives, but would certainly lose in circulation, and probably be prosecuted for indecency.

The same thing is true of insulin. The worst sufferers from diabetes can regain full health and keep it indefinitely by two or three daily injections. But they cannot be got to realise this fact, because they have never been taught that their bodies are systems obeying quite definite laws, and a diabetic will no more work without insulin than a motor-car without lubricating oil. A medical friend recently had to deal with two women brought in dying of diabetes to the hospital where he worked. Both had been treated before, and taught to inject themselves twice daily with insulin. But one had broken her syringe and had not troubled to replace it at once, while the other had neglected her injections for two days because she was coming to hospital in any case for another complaint. Attitudes like this are so common that the discovery of insulin has made no appreciable difference to the mortality in England from diabetes. It has saved a few intelligent people, but that is all.

If a definitive cure for cancer is discovered in the next few years it is unlikely that it will be a simpler or safer affair than that of diabetes. If so it will not have much effect on the mortality for several generations. In such a case any given person can no doubt flatter himself on belonging to the intelligent minority who will be saved. But if what science arrives at is not a cure, but a means of prevention, the case is even less hopeful. Experience has shown that in this respect individual action is almost useless. In a country where typhoid fever is common it is hard always to drink beer or wine, or personally to see that one's water is boiled ; and annual inoculation involves a day's mild illness. Typhoid infection can only be dealt with adequately by public control of the water supply, which involves no effect by individual citizens. Diphtheria, small-pox, measles, and other air-borne diseases, could be stamped out by a public effort, but such an effort would involve the individual assistance

and self-sacrifice of sick persons and their relatives, and also international co-operation. It is impossible until people realise that microbes are every bit as real as foreigners, and much more likely to kill one. They will only arrive at a sane view regarding disease as the result of a general education on scientific lines. The study of medicine apart from its scientific basis creates neurotics rather than scientists.

Preventive medicine could be made into the moral equivalent of war. It is already so for a few people. A colleague of mine was recently translating a French paper on chemotherapy when he came upon the phrase " tué par l'ennemi " in reference to a deceased pharmacologist. " I suppose," he said, " that means that he died of an accidental infection." I undeceived him ; the enemy in this case had been the German nation ; but his attitude was typical of medical scientists to-day. " For we wrestle, not against flesh and blood, but against principalities, against powers, against the rulers of the darkness of this world." St. Paul thought that the world was largely ruled by demons. We know better to-day, and we demand the general adoption of the scientific point of view because in its absence human effort is so largely devoted to conflicts with fellow-men, in which one, if not both, of the disputants must inevitably suffer. It is only in times of disaster that the average man devotes a moment's thought to his real enemies, " the rulers of the darkness of this world " from bacteria to cyclones. Until humanity adopts the scientific point of view those enemies will not be conquered.

This adoption will inevitably be a slow process. But it will be quite unnecessarily slow unless those who desire it realise the nature of the opposition to it. One of the necessary pre-requisites is adequate biological teaching in schools. Such teaching will only be adequate if it brings biology into relation with daily life. In an agricultural community this would be possible by a study of agricultural plants and animals. In towns it can only come through the study of human anatomy and physiology, man being the only living organism familiar to the urban child. Any attempt to teach these subjects involves the violation of the most formidable taboos. Some of these still obstruct the teaching even of medical students.

The first of these taboos concerns human corpses. Every educated person should know what his or her inside looks like. Models and dead rabbits do not produce the necessary effect on

the mind. It was not until I had attended a few post-mortems that I realised (with da Vinci, Wren, and others) that even the ugliest human exteriors may contain the most beautiful viscera, and was able to console myself for the facial drabness of my neighbours in omnibuses by dissecting them in my imagination. I do not suppose that I shall live to see this point of view generally adopted, but the first step towards it should be made by the prospective corpses. I feel no more personal interest in the disposal of my corpse or my wife's than of our old boots. They will, therefore, I hope, be used as anatomical material.

The second objection is on religious grounds. It is impossible to reconcile our physiological knowledge with the curious fragments of archaic physiology which are imbedded here and there in religious doctrine. It may be possible for religion to discard them as it has discarded the solid heaven theory. But many religious persons do not think so. Certainly the physiology of the brain is likely to prove as great a stumbling-block in this century as did the doctrine of evolution in the last.

The most serious opposition, however, comes from a third source. Human physiology is indecent. To take a simple example, it would be ridiculous to frame a practical course of that science which did not involve the analysis of urine, or a theoretical course which omitted the physiology of reproduction. Most people desire that thought on the latter subject should remain in the pre-scientific stage, and heavily charged with emotion. The emotion may vary in different cases. Some find it a subject for sentimentality, others for disgust, others, again, for humour. All agree in fearing an objective and scientific attitude to it, though this fear is rationalised in a number of different ways. As a consequence a considerable proportion of the rising generation is adopting a purely hedonistic standpoint on this topic. I think that those who are conservative in this matter should realise that, from their point of view, a biological attitude is preferable to a hedonistic. The biologist, for example, generally finds it improbable that a woman should find satisfaction in permanently interrupting the normal reproductive cycle so as to omit pregnancy and lactation, even though a low infantile mortality necessitates a certain degree of interference on social grounds.

For reasons such as these the educational preliminaries to a scientific point of view will meet with the most formidable resistances, largely unconscious. But until the scientific point

of view is generally adopted, our civilisation will continue to suffer from a fundamental disharmony. Its material basis is scientific, its intellectual framework is pre-scientific. The present state of the world suggests that unless a fairly vigorous attempt is made in the near future to remedy this disharmony, our particular type of civilisation will undergo the fate of the cultures of the past. Those who consider that it is worth saving should realise the kind of effort which is necessary, and the kind of opposition which that effort will encounter.

Dostoevski and Parricide

Dr. Siegmund Freud. *Translated by* D. F. Tait

FOUR facets may be distinguished in the rich personality of Dostoevski: the creative artist, the neurotic, the moralist, and the sinner. How is one to find one's way in this bewildering complexity?

The creative artist is the least doubtful; Dostoevski's place is not far behind Shakespeare. *The Brothers Karamazov* is the most magnificent novel ever written; the episode of the Grand Inquisitor, one of the peaks in the literature of the world, can hardly be over-praised. Unfortunately, before the problem of the creative artist, analysis must lay down its arms.

The moralist in Dostoevski is the most readily assailable. If we try to rank him high as a moralist on the plea that only a man who has gone through the depths of sin can reach the highest heights of morality, we are neglecting one consideration. A moral man is one who reacts to the temptation he feels in his heart without yielding to it. The man who alternately sins, and in his remorse makes high moral demands, lays himself open to the reproach that he has made things too easy for himself. He has not achieved the most important thing in morality, renunciation, for the moral conduct of life is a practical human interest. He reminds one of the barbarians of the great migrations, who murder and do penance therefor, where penitence becomes a technique to enable murder to be done. Ivan the Terrible behaved in exactly this way—in fact, this compromise with morality is a characteristic Russian trait. Nor was the ultimate result of Dostoevski's moral struggles anything very glorious. After the most violent battles to reconcile the impulsive claims of the individual with the demands of the community, he ended up, retrograde fashion, with submission both to the temporal and the spiritual authorities, with veneration for the Tsar and the God of the Christians, and a narrow Russian nationalism, a position which lesser minds have reached with less effort. This is the weak point of the great personality. Dostoevski threw away the chance of becoming a teacher and liberator of humanity; instead, he appointed himself its gaoler. The future of civilisation will have little to thank him for. It is probable that he was condemned to such frustration by his neurosis. The greatness

of his intellect and the strength of his love for humanity should have opened to him another, apostolic, way of life.

To treat Dostoevski as a sinner and a criminal rouses violent resistance which need not be based on the philistine assessment of the criminal. The real motive soon becomes apparent: two traits are important in the criminal, boundless egoism and a strong destructive tendency, both in conjunction; and the condition for their expression is the absence of love, the lack of an affective valuation of (human) objects. One immediately recalls the contrast presented by Dostoevski, his great need of love and his enormous capacity for love, which expressed itself in manifestations of superhuman goodness, and enabled him to love and help where he was justified in hatred and revenge—for example, in his relations with his first wife and her lover. That being so, we have to ask whence comes the temptation to reckon Dostoevski among the criminals. The answer is that it comes from his choice of material, which singles out from all others violent, murderous, and egoistic characters, which points to the existence of similar tendencies in his own soul, and also from certain facts in his life, like his passion for gambling, and perhaps the sexual abuse of a young girl (*A Confession*[1]). The contradiction is resolved by the perception that Dostoevski's very strong destructive impulse, which might easily have made him a criminal, was in his life directed mainly against his own person (inward instead of outward), and thus found expression in masochism and the sense of guilt. His personality, moreover, contains sadistic characteristics in plenty, which are expressed in his irritability, his love of tormenting, and his intolerance even towards persons he loved, and which appear also in the way in which, as an author, he treats his readers. That is, in little things he was a sadist to others, in bigger things a sadist to himself, that is, a masochist, who is the mildest, kindliest, most helpful human being possible.

We have explored three factors in Dostoevski's complex personality, one quantitative and two qualitative: his extra-

[1] See the discussion of this point in *Der unbekannte Dostojewski*, 1926. Stefan Zweig says: "He does not stop before the chambers of bourgeois morality, and no one can say exactly how far he transgressed the bounds of law in his own life, or how much of the criminal instincts of his heroes was realised in him" (*Drei Meister*, 1920). For the intimate relations between Dostoevski's characters and his own experiences, see the arguments in the introductory section of René Fülöp-Miller's *Dostojewski am Roulette*, 1925, which relate to Nikolai Strakhov.

ordinary degree of affectivity, the perverse impulsive structure which inevitably marked him out as a sado-masochist or a criminal, and his unanalysable artistic endowment. This combination might very well exist without a neurosis; in fact, there are no neurotic complete masochists. But, according to the balance of forces between the impulse claims and the inhibitions opposing them (*plus* the available methods of sublimation), Dostoevski would still have to be classified as a so-called "impulsive character." But the position is obscured by the presence of the neurosis, which, as I have already said, is not in the circumstances indispensable, but which comes into being all the more readily, the richer the complexity which has to be controlled by the ego. For the neurosis is only a sign that the ego has not succeeded in making a synthesis, that it has forfeited its harmony in making the attempt.

How then does the neurosis in the strict sense show itself? Dostoevski called himself an epileptic and was accepted as such by other people, on the strength of his serious attacks, which were accompanied by loss of consciousness, muscular convulsions, and subsequent depression. Now it is highly probable that this so-called epilepsy was only a symptom of his neurosis, and must, accordingly, be classified as hystero-epilepsy, that is, as serious hysteria. We cannot be completely certain on this point for two reasons, first, because the medical data on Dostoevski's "epilepsy" are defective and untrustworthy, and secondly, because our understanding of morbid conditions combined with epileptiform attacks is imperfect.

To take the second point first. It is unnecessary to reproduce here the entire pathology of epilepsy; it would serve no useful purpose. But this may be said. The old *morbus sacer* is still in evidence as an ostensible clinical entity, the mysterious disease with its incalculable, apparently unprovoked convulsive seizures, its changing of the character into irritability and aggressiveness, and the progressive decline of all the mental faculties. But in the last resort this picture flickers and becomes blurred. The seizures, the onset of which is savage, accompanied by biting of the tongue and incontinence of urine, working up to the dangerous *status epilepticus*, may, however, be reduced to brief periods of absence, mere transient loss of consciousness, and may be replaced by short periods in which the patient, under the control of the unconscious, does something foreign to his character. Although otherwise conditioned

by purely physical causes in a way we do not understand, the first appearance of the attacks may be due to some purely psychical influence (fright), or, further, they may react to psychic stimuli. However characteristic intellectual impairment may be of the overwhelming majority of cases, at least one case is known in which the affliction did not interfere with the functioning of the highest intellectual faculties (Helmholtz). (Other cases of which the same fact is alleged are either uncertain or open to the same objections as that of Dostoevski himself.) Patients who are victims of epilepsy may give an impression of dullness and arrested development, just as the disease is frequently accompanied by the most palpable idiocy and the most serious mental defects, even although these are not a necessary element of the clinical picture. These seizures, however, with all their variations, also occur in persons who show complete mental development, and who, previous to their onset, possess an excessive, generally imperfectly controlled affectivity. It is no wonder in these circumstances that it has been found impossible to determine a single clinical entity, " epilepsy." The similarity of the external symptoms seems to demand a functional conception, as if the mechanism of the abnormal impulsive discharge were organically prepared in advance, to be called upon in quite different conditions, both during disturbances of the cerebral activity due to serious histolytic and toxic affections, and also in case of inadequate control of the psychic economy, the action of the energy working in the soul in a crisis. But behind the division we glimpse the identity of the fundamental mechanism of the impulsive outlet. The same thing must to some extent apply to sexual processes : the earliest doctors called the *coitus* a little epilepsy, that is, they recognised in the sexual act a mitigation and adaptation of the epileptic irritation outlet.

The " epileptic reaction," as this common element may be called, without doubt also places itself at the disposal of the neurosis, the essence of which is to get rid, by somatic means, of masses of stimuli which it cannot deal with psychically. The epileptic seizure is thus a symptom of hysteria ; and is adapted and modified by it, as is also done by the normal sexual discharge. It is, therefore, quite right to distinguish between organic and " affective " epilepsy. The practical significance of this is that the person who suffers from the one kind is mentally disordered, and the person who suffers from

the other, a neurotic. In the first case, the psychic life is subject to an alien disturbance from without; in the second, the disturbance is an expression of the psychic life itself.

It is extremely probable that Dostoevski's epilepsy was of the second kind. This cannot, strictly speaking, be proved; to do that one would have to be able to fix the first appearance of the epilepsy and the subsequent fluctuations of the attacks in the continuity of his psychic life, and for that we know too little. The descriptions of the seizures themselves teach us nothing, our information about the relations between the seizures and Dostoevski's experiences are defective and often inconsistent. The most probable assumption is that the attacks go back to his childhood, that the symptoms were mild to start with, and did not assume epileptic form until after the terrible experience of his eighteenth year, the murder of his father.[1] It would be very convenient if it could be established that the attacks ceased entirely during his exile in Siberia, but other accounts are opposed to this.[2]

The unmistakable connection between the murder of the father in *The Brothers Karamazov* and the fate of Dostoevski's father has struck more than one of his biographers, and has caused them to refer to a "certain modern psychological school." A psychoanalytical consideration—for it is psychoanalysis that is meant—is tempted to see in this event the most serious *trauma*, and in Dostoevski's reaction to it, the crucial point of his neurosis.

[1] See René Fülöp-Miller's article, *Dostojewski's Heilige Krankheit*, in *Wissen und Leben*, Nos. 19/20, 1924. Of especial interest is the information that in the novelist's childhood, "something terrible, agonising and unforgettable" happened, to which the first signs of his disease may be traced (Suvorin in an article in the *Novoe Vremia* for 1881, quoted in the introduction to *Dostojewski am Roulette*, page xlv). Further, Orest Miller in *Dostojewski's autobiographische Schriften* says: "There is, however, another special piece of evidence about Fedor Mikhailovich's illness, which relates to his earliest youth, and brings the illness into relation with a tragic event in the family life of his parents. But, although this piece of evidence was given to me orally by one who was a close friend of Dostoevski, because I can nowhere find confirmation of it, I am unable to make up my mind to give an exact and detailed account of it" (page 140). Biographers and scientific researchers cannot be grateful for this discretion.

[2] Most of the accounts, including Dostoevski's own, maintain rather that the illness first assumed a definite epileptic character during the exile in Siberia. Unfortunately there is reason to distrust the autobiographical accounts of neurotics. Experience shows that their memories introduce falsifications designed to break down an unpleasant causal connection. Nevertheless, it appears certain that his time in a Siberian prison markedly altered Dostoevski's morbid state. Cf. *Dostojewski's Heilige Krankheit*, page 1186.

But if I undertake to substantiate this idea by means of psychoanalysis, I expose myself to the danger of being unintelligible to all those readers who are unfamiliar with the language and teaching of psychoanalysis.

We have one certain starting-point. We know the meaning of the first attacks from which Dostoevski suffered in his early youth, long before the incidence of the " epilepsy." These attacks had a death significance : they were brought on by the fear of death and consisted of a lethargic somnolent condition. The disease first came upon him as a boy in the form of a sudden groundless melancholy, " a feeling," as he later told his friend Soloviev, " that I was going to die on the spot, and this was actually followed by a state exactly similar to real death. . . ." His brother Andrei tells us that in his childhood Fedor used to leave little notes about before he went to sleep ; he was afraid that he would fall into a deathlike sleep during the night and begged that his burial should be postponed for five days. (*Dostojewski am Roulette,* Introduction, page lx.)

We know the meaning and intention of such death seizures. They signify identification with a dead person, either one who is really dead, or one still alive whom one wishes dead. The latter case is the more important. The attack has then the value of a punishment. You have wished another person's death, you become that person and are yourself dead. Psychoanalytic doctrine here makes the assertion that this other person for a boy is usually the father ; the hysterical attack is thus a punishment for having wished for the death of a hated father.

Parricide is, according to a well-known conception, the chief and primitive crime of humanity as well as of the individual.[1] It is in any case the main source of the sense of guilt ; we do not know if it is the only one. Researches have not yet established the psychic origin of guilt and the need for expiation. But it is not necessary for it to be the only one. The psychological position is complicated and requires explanation. The relation of the boy to the father is, as we say, an " ambivalent " one (that is, composed of conflicting feelings of tenderness and hostility). In addition to the hate which wants to remove the father as a rival, a measure of tenderness for him also exists as a rule. Both attitudes of mind combine to produce

[1] See the author's *Totem und Tabu.*

identification with the father: the boy wants to be in his father's place because he admires him and wants to be like him, and also because he wishes to put him out of his way. This evolution now comes up against a serious obstacle. At a certain moment the child comes to understand that the attempt to remove the father as a rival would be punished by the father with castration. From fear of castration, that is, in the interests of preserving his virility, arises also a wish to possess his mother and to remove the father. So far as this wish remains in the unconscious, it forms the basis of the sense of guilt. We believe that we are here describing normal processes. We have, it is true, to make an important amplification in the normal fate of the so-called " Oedipus complex."

A further complication arises when the constitutional factor we call bi-sexuality is more strongly developed in the child. Then, under the influence of the threat to virility by castration, the tendency is strengthened to deflect in the direction of effeminacy, to put oneself in the place of the mother and take over her part as the object of the father's love. Only the fear of castration makes this also impossible. The child understands that he must suffer castration if he wants to be loved by the father as a woman. Thus, both impulses, hatred for the father and being in love with the father, become repressed. There is a certain psychological difference in the fact that the hatred of the father is abandoned in consequence of the fear of an external danger (castration), while the amorous feeling towards the father is treated as an inward impulse danger, although fundamentally it goes back to the above-mentioned external danger.

What makes hatred for the father untenable is fear of the father: castration is terrible, both as a punishment and as the price of love. Of the two factors which repress the hatred of the father, the first, the direct dread of punishment and castration, may be called the normal one, the pathogeneous reinforcement seems to come only with the second factor, the fear of the feminine attitude. Thus a strong bi-sexual predisposition becomes one of the conditions or confirmations of the neurosis. Such a predisposition must certainly be assumed in Dostoevski and shows itself in a possible form (latent homosexuality) in the important part played by male friendships in his life, in his extraordinarily gentle attitude to rivals in love, and in his remarkable understanding of situations which are explainable

only through repressed homosexuality, as many examples from his novels show.

I regret, although I cannot alter the facts, that these ideas about these attitudes of hate for and love of the father and their transformations under the influence of the threat of castration, will appear unsavoury and incredible to readers unfamiliar with psychoanalysis. I should expect that it would be the castration complex that would arouse the most general repugnance. I can only assert that psychoanalytic experience has put these relations beyond the reach of doubt, and has taught us to recognise in them the key to every neurosis. This key we must then apply to our author's " epilepsy." So strange to our consciousness are the things by which our unconscious psychic life is controlled ! The consequences of the repression of the hatred of the father in the Oedipus complex are not exhausted by the foregoing observations.

A new factor is that the identification with the father ultimately compels for itself a permanent place in the ego. It is adopted into the ego, but it there appoints itself a special instance for the rest of the content of the ego. We call it the super-ego, and ascribe to it, the inheritor of the parental influence, the most important functions.

If the father was hard, violent, and cruel, the super-ego takes these characteristics from him, and in its relation to the ego, the passivity which was supposed to have been repressed reestablishes itself. The super-ego has become sadistic, the ego becomes masochistic, that is to say, fundamentally passive like a woman. The ego has a great craving for punishment, which is partly provided by fate and partly finds satisfaction in ill-treatment by the super-ego (consciousness of guilt). Every punishment is at bottom castration, and, as such, a fulfilment of the old passive attitude to the father. Even fate is ultimately only a later father projection.

The normal processes in the formation of the conscience must be similar to the abnormal ones described here. We have not yet succeeded in fixing their boundaries. It will be noted that ultimately the largest share is ascribed to the passive component, the repressed femininity. Moreover, as an accidental factor, it is of importance whether the father, who is feared in any case, was in reality especially violent. This is true in Dostoevski's case, and we shall trace back both his extraordinary sense of guilt and masochistic conduct to a very strong feminine

component. Thus the formula for Dostoevski is as follows : a person of particularly strong bi-sexual predisposition, who can defend himself with special intensity against dependence on an especially hard father. The character of bi-sexuality we add to the earlier-mentioned components of his nature. The youthful symptom of the death-like seizures is thus explained as a father identification of the ego, admitted by the super-ego as a form of punishment. You wished to kill your father in order to be your father. Now you are the father, but the dead father. The ordinary mechanism of hysterical symptoms. And further : Now your father kills you. For the ego the death-symptom is a phantasy satisfaction of the male wish, and, at the same time, a masochistic satisfaction ; for the super-ego, it is a punishment satisfaction, that is, a sadistic satisfaction. Both of them, the ego and the super-ego, carry on the rôle of the father. To sum up, the relation between the person and the father object, by retaining its content, is transformed into a relation between the ego and the super-ego, a new setting on a fresh stage. Such infantile reactions from the Oedipus complex may disappear if reality gives them no further nourishment. But the character of the father remains the same, or rather, it deteriorates with the years, and so Dostoevski's hatred for the father, his wish for the death of this wicked father, is maintained. Now it is dangerous if reality fulfils such repressed wishes. Phantasy has become reality, all defensive measures are reinforced. Dostoevski's seizures now assume an epileptic character ; they still of course signify the father identification as a means of punishment, but they have become terrible, like the frightful death of the father itself. What further content they have absorbed, particularly sexual content, escapes conjecture.

One thing is noteworthy. In the aura of the epileptic attack, one moment of supreme happiness is felt, which may very well have been the fixation of the triumph and the liberation felt at hearing the news of the death, to be followed immediately by an all the more cruel punishment. We have divined just such a sequence of triumph and mourning, festive joy and mourning, in the brothers of the primal horde who murdered their father, and we find it repeated in the ceremony of the funeral feast. If it had happened that Dostoevski had been free from his seizures in Siberia, this would only substantiate the view that his seizures were his punishment. He

did not need them any longer, when he had been punished in another way. But this cannot be proved. Rather does the necessity of punishment felt by Dostoevski's psychic economy explain the fact that he lived through these years of misery and humiliation without breaking down. Dostoevski's sentence as a political offender was unjust; he must have been aware of this, but he accepted this undeserved punishment at the hands of the Tsar, the Little Father, as a substitute for the punishment he deserved for his sin against his real father. Instead of punishing himself, he let himself be punished by his father's deputy. We glimpse here a proof of the psychological justification of penalties imposed by society. It is a fact that large groups of criminals long for punishment. Their super-ego demands it, thus saving itself from inflicting the punishment.

Everyone who is familiar with the complicated transformation of meaning undergone by hysterical symptoms will understand that no further attempt will be made here, beyond this beginning, to fathom the meaning of Dostoevski's attacks.[1] It is enough that we may assume that the original meaning remains unchanged behind all later overlayings. It may be said that Dostoevski never got free from the remorse due to his desire to murder his father. It also determined his attitude to the two other domains in which the father relation is the decisive factor, the authority of the State and religion. In the first he ended up with complete submission to the Tsar, the Little Father, who in reality had once played with him the comedy of murder which his attacks so often preluded for him. Here penitence gained the upper hand. In the religious sphere he retained more freedom: according to apparently reliable reports, up to the last instant of his life, he wavered between faith and atheism. His great intellect made it impossible for him to overlook a single one of the intellectual difficulties to which faith leads. By an individual repetition of historical evolution, he hoped to find a way out and a redemption from guilt in the Christ ideal, to use his very sufferings as a claim

[1] See *Totem und Tabu*. The best account of the meaning and content of his seizures was given by Dostoevski himself, when he told his friend Strakhov that the irritability and depression which followed an epileptic seizure were due to the fact that he seemed to himself a criminal, and could not get rid of the feeling that he was guilty of an offence unknown to him, that he had committed a terrible evil deed, which oppressed him (*Dostojewski's Heilige Krankheit*, page 1188). In these complaints, psychoanalysis sees a proof of recognition of the "psychic reality," and tries to bring a knowledge of the unknown offence to the surface of consciousness.

to a Christ rôle. That he did not entirely succeed in this and become a reactionary was due to the fact that the universal human filial guilt, on which religious feeling is built, had in him attained to a super-individual strength, and remained insuperable even to his great mind. Here we are laying ourselves open to the objection that we have abandoned the impartiality of analysis, and are subjecting Dostoevski to values which are justifiable only from the partial standpoint of a definite philosophy. A conservative would take the side of the Grand Inquisitor, and judge Dostoevski differently. The objection is just ; one can only say in extenuation that Dostoevski's decision appears to have been determined by an intellectual inhibition due to his neurosis.

It can scarcely be mere coincidence that three of the masterpieces of the literature of all time, the *Oedipus Rex* of Sophocles, Shakespeare's *Hamlet*, and Dostoevski's *The Brothers Karamazov*, should all deal with the same subject, a father's murder. In all three, too, the motive for the deed, sexual rivalry for the woman, is laid bare. The most straightforward is certainly the representation in the drama built up on the Greek legend. In it the hero himself commits the crime. But poetic treatment is impossible without softening and disguise. The naked confession of a desire to murder a father, as we arrive at it in analysis, seems intolerable to people without analytical training. The Greek drama, while retaining the crime, introduces the indispensable toning-down in a masterly fashion by projecting the motive of the hero into the real as a compulsion of destiny external to himself. The hero commits the fatal deed unintentionally and apparently uninfluenced by the woman ; the connection is, however, preserved by making the winning of the Queen-mother dependent on a repetition of the deed on the Sphinx, the monster which symbolises the father. After the guilt is revealed to consciousness, the hero makes no attempt to exculpate himself by appealing to the expedient of the compulsion of destiny. The guilt is recognised and punished as a conscious crime, which is bound to appear unjust, but which psychologically is perfectly right. The presentation in the English play is more indirect : there the hero does not commit the crime himself ; it is committed by another, for whom it is not parricide. The revolting motive of sexual rivalry for the woman does not, therefore, need to be disguised. Also, we see the Oedipus complex of the hero, as it were, in a reflected light,

by learning the effect on him of the other's crime. He has to avenge the crime, but proves in a very remarkable way incapable of doing so. We know that it is his remorse that cripples him ; in a way quite consistent with neurotic processes, the remorse is displaced upon the perception of his inadequacy for fulfilling his task. There are signs that the hero feels this guilt as a super-individual one. He despises others no less than himself : " Use every man after his desert, and who should 'scape whipping ? "

The Russian novel goes a step farther in this direction. Here also the murder is committed by another, but that other is one who stands to the murdered man in the same filial relation as the hero, Dmitri, another, in whom the motive of sexual rivalry is openly admitted, and to whom Dostoevski has most remarkably attributed his own disease, alleged epilepsy, as if he were trying to confess that the epileptic, the neurotic, in him was a parricide. Then follows in the speech for the defence the famous mockery of psychology, which is a double-edged weapon. A magnificent disguise, which has only to be turned round to discover the deepest meaning of Dostoevski's conception. It is not psychology which deserves mockery, but the procedure of judicial examination. It is a matter of indifference who actually committed the crime ; psychology is interested only in discovering who desired it, and who welcomed it when it was done, and for that reason, all the brothers are equally guilty, even the sharply-contrasted figure of Aliosha, the impulsive sensual man, the sceptical cynic and the epileptic criminal. In *The Brothers Karamazov* we find one very significant scene. The starets in his conversation with Dmitri has discovered that Dmitri bears in himself a readiness to murder his father, and throws himself at his feet. It is impossible that this is meant as an expression of admiration ; it must signify that the holy man is rejecting the temptation to despise or shrink from the murderer, and, therefore, humiliates himself before him. Dostoevski's sympathy for the criminal is in fact boundless : it goes far beyond the pity which the unhappy wretch can claim, and reminds us of the " sacred awe " with which epileptics and lunatics were treated in olden days. The criminal is to him almost a Redeemer, who has taken on himself the guilt which others would otherwise have had to bear. One need not now commit murder, after he has committed murder, but one must be grateful to him, because, without him, one

would oneself have to have been a murderer. That is not pure kindliness and sympathy; it is identification on the basis of a similar murderous impulse, in reality a slightly displaced narcissism. This is not to dispute the ethical value of this kindliness. Perhaps the mechanism of kindly sympathy in other men is the same, only it is particularly easy to discern in the extreme case of the novelist, who was ridden by the sense of guilt. There is no doubt that this identifying sympathy was a decisive factor in determining Dostoevski's choice of material. He dealt first with the common criminal—the criminal from egoism—the political and the religious criminal, and not until the end of his life did he come back to the primal criminal, the parricide, and in him made his poetical confession.

The publication of Dostoevski's posthumous papers and of the diaries of his wife has thrown a bright light on one episode in his life, namely the period in Germany when he was obsessed with the gambling mania (*Dostojewski am Roulette*), which it is impossible to regard otherwise than as an unmistakable fit of pathological passion. There was no lack of ways of rationalising this remarkable and unworthy behaviour. As often happens with neurotics, the sense of guilt had taken tangible shape in the form of a burden of debt, and Dostoevski was able to take refuge behind the pretext that he was trying by his winnings at the tables to make it possible for him to return to Russia without being arrested by his creditors. But that was only a pretext; Dostoevski was acute enough to recognise this and honest enough to confess it. He knew that the chief thing was the gambling in itself, *le jeu pour le jeu*.[1] All the details of his impulsively irrational conduct show this, and something more as well. He never rested until he had lost everything. Gambling was for him also a method of self-punishment. He had time and again given his young wife his promise or his word of honour not to play again, or not to play again on a particular day, and, according to her, he almost always broke it. When his losses had reduced himself and her to the direst need, he derived a second pathological satisfaction from that. He could abuse and humiliate himself to her, invite her to despise him and to regret that she had married an old sinner; and when he had unburdened his conscience in this way, the

[1] "The main thing is the gambling itself," he wrote in one of his letters. "I swear that greed for money has nothing to do with it, although Heaven knows I am sorely in need of money."

gambling was resumed next day. The young wife accustomed herself to this cycle, because she had noticed that the one thing which offered any real hope of escape, namely his literary activity, was never more successful than when they had lost everything and pawned their last possessions. Naturally she did not understand the connection. When his sense of guilt was satisfied by the punishments he had imposed on himself, the inhibitions to work ceased to operate, and he allowed himself to take a few steps on the way to success.[1]

What part of long-buried childhood compels its repetition in the gambler's compulsion may without difficulty be divined from a story by a young novelist. Stefan Zweig, who, by the way, has himself devoted a study to Dostoevski (*Drei Meister*), in a collection of three long short stories, *Die Verwirrung der Gefühle* (*The Confusion of the Emotions*), has a story which he calls *Vierundzwangzig Stunden aus dem Leben einer Frau* (*Four and Twenty Hours in a Woman's Life*). This little masterpiece ostensibly purports only to show what an irresponsible creature woman is, and to what excesses, surprising even to herself, an unexpected experience may drive her. But the story tells far more than this: when it is subjected to an analytical interpretation it represents without such apologetic tendencies something quite different, something universally human or rather masculine. And such an interpretation is so obvious that it cannot be denied. It is characteristic of the nature of artistic creation that the author, who is a personal friend, was able to assure me that the interpretation given by me was completely alien both to his mind and his intention, although many details were woven into the narrative which seemed expressly designed to indicate the secret clue. In the story a distinguished elderly lady tells the author of an experience she had had twenty years before. She had been left a widow when still young, and was the mother of two sons, who no longer needed her. Expecting nothing further from life, at the age of forty-two, on one of her aimless journeyings, she visited the Casino at Monte Carlo, where, among all the remarkable sights of the place, she was soon fascinated by two hands, which seemed to betray all the feelings of the unlucky gambler

[1] "He always remained at the gambling tables until he had lost everything and was completely ruined. It was only when the damage was complete that the demon at last retired from his soul and made way for the creative genius." (René Fülöp-Miller, *Dostojewski am Roulette*, page lxxxvi).

with terrifying sincerity and intensity. These hands belonged to a handsome young man—the author unintentionally makes him the same age as the eldest son of the narrator—who, after having lost everything, left the room in the depths of despair, evidently with the intention of ending his hopeless life in the gardens. An inexplicable feeling of sympathy compels her to follow him and make every effort to save him. He takes her for one of the importunate women so common there, and tries to shake her off; but she stays with him and finds herself obliged in the most natural way possible to share his room at the hotel, and finally his bed. After this improvised night of love, she exacts from the young man, now apparently calmed down, a promise that he will never play again, provides him with money for his journey home and undertakes to meet him at the station before the departure of the train. Then she begins to feel a great tenderness for him, wants to sacrifice everything to keep him, and makes up her mind to go with him instead of saying good-bye. Various adverse circumstances make her miss the train, and in her longing for the lost one, she again visits the gaming rooms, and there, to her horror, sees once more the hands which had first excited her sympathy: the faithless boy had gone back to his gambling. She reminds him of his promise, but, obsessed by his passion, he calls her a spoil-sport, tells her to get out, and flings down the money with which she had tried to save him. She hurries away deeply mortified, and learns later that she has not succeeded in rescuing him from suicide.

This brilliantly told, perfectly motivated story indeed exists in its own right, and is certain of deeply affecting all readers. But psychoanalysis shows us that its invention is based on the extinction of a wish phantasy belonging to the period of puberty, which many people consciously remember. The phantasy embodies a wish that the mother should herself initiate the boy into sexual life in order to save him from the dreaded evils of onanism. All the "release" poetic inventions which we find so frequently, have the same origin. The vice of onanism is replaced by the passion for gambling; the emphasis laid on the passionate activity of the hands betrays this derivation. The gambling mania is actually an equivalent of the old onanism compulsion; "playing" is the very word used in the nursery for the activity of the hands in masturbation. The irresistibility of the temptation, the solemn, never kept, resolutions

never to do it, the soothing pleasure, and the bad conscience which tells him that he is ruining himself (suicide), remain unaltered in the substitution. Zweig's story is told from the point of view of the mother, not of the son. The son may cajole himself by thinking: if my mother knew what dangers onanism may involve me in, she would certainly save me by permitting me to lavish my tenderness on her own body. The identification of the mother with the prostitute made by the young man in the story belongs to the same phantasy. It brings the unattainable within easy reach. The bad conscience which accompanies this phantasy entails the unhappy ending of the story. It is also interesting to note how the external circumstances employed by the author in the story try to conceal its analytic meaning. For it is extremely questionable whether the love life of woman is controlled by sudden and mysterious impulses. Analysis rather goes to show that there is adequate motivation for the surprising behaviour of a woman who has hitherto rejected love. Faithful to the memory of her dead husband, she has armed herself against all similar claims, but—and here the phantasy of the son is right—she, as mother, has not escaped transference of love to the son, of which she is entirely unconscious, and fate is able to capture her at this undefended spot.

If the gambling habit, with its unsuccessful struggles to break oneself from it and its opportunities for self-punishment, is a repetition of the onanism compulsion, we shall not be surprised that it gained such a firm place in Dostoevski's life. We find no case of serious neurosis in which the autoerotic satisfaction of immaturity and puberty does not play its part, and the relations between the efforts to suppress it and the fear of the father are so well known that they need only be mentioned.[1]

[1] Most of the views here expressed are also contained in the excellent book of Solan Neufeld, published in 1923, *Dostojewski, Skizze zu seiner Psychoanalyse.*

The Future of the Earth

HAROLD JEFFREYS

PART II

THE COOLING OF THE EARTH

THE temperature of the earth's surface is determined almost entirely by the sun's radiation. Even a temporary reduction in the amount of heat that a given spot on the surface receives from the sun makes a marked difference in the local temperature. The fall of temperature during the night may be 10° to 20° F. (6° to 11° C.), owing primarily to cooling by radiation into space in the absence of heating by absorption of energy from the sun. The mean difference of temperature between the poles and the equator is about 70° C., in spite of the continual interchange due to air currents. Heat reaches the earth's surface from other sources, such as radiation from the stars, conduction from the earth's interior, and evolution of hot gases from volcanoes. But all of these are insignificant compared with the dominating effect of the sun. Any change in the latter will therefore be reflected in the temperature of the earth's surface. Now we have seen that the sun has probably been in nearly the same state as long as the earth has existed, and it would not therefore be expected that the earth's surface would have cooled systematically. This agrees with geology, though temporary fluctuations, involving glacial periods, have occurred from time to time. But when we consider the remote future, the changes in the sun become of paramount importance in determining climate. The radiation sent out per second from a star with anything like the sun's mass is proportional roughly to the fourth power of the mass, and therefore will decrease as the sun loses mass. In addition, as the sun's mass declines the planets will recede from the sun. When the sun's mass has sunk to a tenth of its present value, the earth will be ten times as distant from the sun as it is now, that is to say, about the present distance of Saturn. At this stage, therefore, the radiation from the sun received by the earth will not be a ten thousandth, but a millionth, of its present value, the extra factor of $\frac{1}{100}$ expressing the fact that the intensity of radiation received from a given source varies as the inverse square of

the distance. Now the body receiving radiation and itself radiating into space adjusts itself to such a temperature that the heat radiated balances that received; the absolute temperature, which is the centigrade temperature with 273° added, is proportional to the fourth root of the intensity of the radiation received. It will therefore be about $\frac{1}{3^1}$ of its present value, or, say, 9° absolute in what we now call temperate latitudes. This is about the boiling point of helium. Long before this stage is reached the surface of the earth will be composed of frozen ocean and desolate continents. In fact a 10 per cent. reduction in the absolute temperature would suffice to freeze the ocean even at the equator, and would be achieved by a 7 per cent. reduction in the sun's mass. This will be achieved in about a billion years. Such a change would suffice to make the earth uninhabitable by the large animals and plants of the present time; but new forms evolved before that time may have solved the problem of living on a frozen and rainless (perhaps nearly snowless) earth.

Meanwhile other changes will have occurred owing to the internal cooling of the earth. Having been born from a gaseous sun it must have been originally gaseous, and it must have passed through a liquid state to its present apparently solid one. There is evidence of the former liquid state in the properties of the central core. Solids can transmit two kinds of elastic waves, longitudinal ones analogous to sound waves in a liquid or gas, and also transverse ones characteristic of solids alone. The study of the waves sent out by earthquakes and travelling through the body of the earth has revealed that the material of the earth is solid and apparently rocky in character nearly half way to the centre. Below that is a central core, which transmits the longitudinal waves, but not the transverse ones. It might on this evidence alone be expected to be a liquid. But there is other evidence. From the study of the elastic waves in the rocky shell we can find out how stiff it is, and hence how much it would yield to such distorting forces as are produced by the moon's tidal action. If the central core were as stiff as the rocky shell, the earth as a whole would yield less than it does. With a liquid core agreement becomes possible. Again, the earth's mean density is 5·5 times that of water; that of surface rocks at most 3·3 times it. There is other information available concerning the distribution of density in the earth, and it all points to the

presence of a deep-seated mass with a density much more than the mean, so much more that it must be made of a different material, and not merely the same stuff in a compressed state. There is no place for a junction of two large bodies of different substances except at the boundary of the liquid core, and when we identify the dense core with the liquid core, we find that its density must be just what iron would have at the actual pressure that must exist at the centre of the earth. Since iron is the commonest heavy metal at the surface, we are led to suppose that the central core is made of iron in a liquid state. There is therefore strong evidence of such internal temperatures as confirm the supposition that the earth was once liquid as a whole. Incidentally such a heated central core has an obvious theological application, particularly as some geophysicists have supposed it to be surrounded by a zone of sulphides.

The history of the outer crust has been much complicated by radioactivity. The radioactive elements have the property of generating heat at a rate depending only on the amount of each element present, and this heats up the rocks that contain them. They are not abundant in the crust, but their effect is considerable. They appear, rather curiously, to be practically confined to the top ten or twenty kilometres of the earth's crust, and must have acquired this distribution while the earth was becoming solid. There are three pieces of evidence pointing this way. First, if the rocks more than about 15 kilometres deep were as radioactive as those at the surface, they would generate more heat than is found by observation to be leaking out at the surface by conduction. Second, the rocks below that depth would never have been able to solidify. Third, there is definite geological evidence that radioactive elements do tend to concentrate upwards when their movement is made possible by fluidity of the substance containing them. When once the upward concentration had been achieved cooling could begin, though not so fast as if there were no radioactive substances present.

The chief interest of internal cooling of the earth by conduction of heat to the surface from the hot interior is that it provides the only coherent explanation of the formation of mountain ranges. The great mountain systems represent regions where the solid upper crust has been fractured or folded along arcs running half-way round the earth. Though

many attempts have been made to explain their formation, only two of them are competent to give forces large enough to fracture the solid crust on such a scale. These two are contraction of the earth's interior and change of its polar flattening. The latter would arise from changes in the earth's rate of rotation, which, we shall see later, have almost certainly occurred. The faster the earth rotates, the more it bulges out around the equator. If then the earth once rotated much faster than it does now, its equator must have been longer, and when it took its present shape, the equator must have been shortened by crumpling. At the same time the polar regions must have been pushed out and stretched. But there seems to be no reason to suppose such changes to be the cause of mountain ranges. The great mountain ranges do not court the tropics and avoid high latitudes, as this view of their origin would indicate; in fact they are most developed in middle latitudes, where changes of rotation produce neither compression nor stretching.

General contraction of the earth's interior, on the other hand, would imply a general distribution of mountains, which is much nearer the truth. A completely regular distribution would not, of course, be expected on a surface diversified as the earth's surface actually is. The phenomena of mountain formation are in general agreement with what would be expected from such a contraction. As the cooling from the outside penetrates to greater and greater depths, more and more does the contraction of the interior due to cooling become. The outside, however, having long since cooled to ordinary surface temperatures, could cool no more. It fitted the inside in the beginning, but when the inside cooled further, the outside was too large to fit it, and was thrown into a state of stress. When the stress became great enough to smash the outer crust it crumpled it up till it again fitted the interior. Then further cooling developed new stresses, and in time a new fracture and a new set of mountain chains were produced. The intermittence of the process is an essential characteristic of the properties of solids. So long as the deformation of the crust required to keep it resting on the interior was only slight, corresponding to a compression in length less than about one part in one thousand, the crust would merely yield elastically without fracture, just as a wire is stretched elastically when hung up with a weight on one end, and recovers its length when the weight is removed.

But there is a limit to the stress such that a solid can recover its form when the stress is removed. In the case of the wire there is a definite load that will break the wire ; in the earth, when the internal contraction exceeds a certain limit the crust can no longer arrange to fit the interior by purely elastic adjustment, and fracture takes place. When fracture once began, new cracks would tend to spread out from the site of the first one ; if a solid has a flaw in it already, that is the place where the next fracture will begin. The crushing would extend until the crust was reduced to such a size that it could fit the interior without being subjected to greater stresses than it could stand. Then the continual cooling of the interior would go on, and ultimately the crust would be again broken and a new epoch of mountain formation would begin. There have been three great periods of mountain formation since the oldest known fossiliferous rocks were formed. The first was the Caledonian, when the mountains of Scotland, Wales, and Scandinavia were made ; the second, the Hercynian folding, made the Appalachian Mountains of the Eastern United States and the Harz Mountains of Germany ; the third, or Alpine folding, made the Alps, Carpathians, Himalayas, and the Rocky Mountains. There were probably several similar epochs before the Caledonian, but they are more difficult to trace.

There are several agreements between prediction and fact that serve as checks on this theory. The amount of compression that rock materials can stand before they are crushed is roughly known : it corresponds to the pressure at the bottom of a column about 3 kilometres in height, and rock under such a thrust is shortened by about $\frac{1}{1000}$ of its natural length. When the elastic stress is relieved by crumpling, the crust is therefore shortened by something of the order of 40 kilometres (probably rather more since the rocks 10 or 20 kilometres down re stronger than surface rocks). This is comparable with the degree of crustal shortening indicated in the great mountain ranges. It is not equal to the folding measured by geologists, but there is now every reason to believe that the latter contains a large secondary part that is not attributable directly to crustal shortening but to subsequent changes caused by residual stresses left in the upper crust where the rocks had been piled up by the original fractures. But there are other considerations based on the height and horizontal extent of the mountains, and their structure as indicated by observations of gravity

on and near them, that give a measure of the crustal shortening in the neighbourhood of 70 kilometres for the Alps and Rockies.

The second check is that if we multiply the crustal shortening in a great mountain system by the number of great epochs of mountain formation believed to have occurred, we get an estimate of the total crustal shortening since the earth's early stages. But if we start with a heated earth, with an upper radioactive layer of the thickness indicated by the present rate of outflow of heat, we can estimate the cooling at all depths since that stage. It corresponds to a contraction, somewhat difficult to calculate on account of difficulties in measuring the thermal expansion of rocks at high temperatures, but certainly of the order of hundreds of kilometres, and in general agreement with the crustal shortening required to account for mountain formation.

The third check is provided by the great chains of the Pacific Coast of America, the Rocky Mountains, the Andes, and their associated chains. The rocks of the continents, to a depth of 10 kilometres or so, appear to have the composition of granite, apart from the upper layer of sediments. This is indicated by the velocities of earthquake waves in this layer, which correspond to mechanical properties similar to those found for granite in the laboratory; and also by the geological facts of the prevalence of granitic masses in the continents and of sediments such as sandstones, which can only have been formed by the destruction of granites that formerly existed. But under the great oceans no granites appear to exist; they are quite absent from oceanic islands. The ocean bottoms must be made of a denser rock. Now it has been found that, among the principal rock types, the denser the rock, the smaller the amount of radioactive matter it contains. This implies less radioactive generation of heat, and therefore the rocks below the oceans will have cooled more since solidification than those of the continents. But as solids cool from their melting points they become stronger, and we should therefore expect the rocks of the ocean bottoms to be stronger than those of the continents. Further, even at the same temperature the dense rocks in question are stronger than granite. Consequently, when the general contraction of the earth pushes the strong ocean bottoms against the weaker continental masses, the latter are the first to give way, and a system of mountains is formed along the coasts. Thus the

mountains of the Pacific Coast appear on this theory as a natural consequence of the greater strength of the ocean floor.

Now looking into the future, we see the cooling of the earth advancing to greater and greater depths, while the resulting contraction produces one mountain system after another. Cooling is not yet great at depths over 500 kilometres or so; and roughly speaking we may say that the depth it has reached at any date is proportional to the square root of the time since the commencement. Since it has reached a depth of 500 kilometres in 1,000 million years or so, it will reach 3,000 kilometres in 36,000 million years from now. Then the whole of the rocky shell will be strong. Meanwhile six times as much contraction will have been produced as has happened hitherto, and perhaps thirty new sets of mountain systems will have appeared. The disentangling of the earth's geological history at that date will have become a serious problem—it is quite difficult enough at the present time. The cooling will actually be somewhat increased by the decay of the radioactive elements. The average life of a uranium atom is about 6,000 million years, and that of a thorium atom about 19,000 million years. Hence in 36,000 million years most of the two chief radioactive generators of heat will have disappeared, and with them their effect on underground temperatures. Kelvin's theory of the cooling of the earth, developed before the discovery of radioactivity, will outlive its deposer.

After the cooling has reached the bottom of the rocky shell it will begin to affect the central core. The details at this stage are doubtful, but the general result is the same in any case. On the well-supported view that the core is of liquid iron, the next stage will be the solidification of the core. At ordinary pressures iron, like water, expands in freezing. If the same is true under the pressure that exists half-way to the centre of the earth, the core will solidify from the margin inwards, and cooling will be by conduction, as during the cooling of the shell. (It is not, of course, strictly correct to speak of the core and the shell as cooling separately. Both are losing heat all the time. But for convenience of description we may speak of the heat as coming from the region where the rate of cooling is greatest at the time in question.) Iron being a much better conductor than rocks, the core will cool more rapidly than the rocks above it, and the earth will be cool to

the centre in a time of the order of 50,000 million years. If, however, the iron at that depth contracts in solidifying the core may cool by convection. But in any case the condition that the heat lost has to be communicated to the outside by conduction through the rocky shell has a controlling influence on the rate of cooling of the core, and the time taken will be of the same order of magnitude. If there is a considerable expansion in solidifying there may be a complication ; it would tend to split the earth open by huge cracks. Nothing so startling as gaping fissures reaching down to the central core, for under high pressure a tendency to plastic stretching would be accommodated by local deformations without actual rupture ; but large open cracks may develop from the surface to a depth of a few kilometres.

In spite of the thirty or so mountain chains yet to be formed, the earth's surface 50,000 million years hence will be comparatively featureless. " Everlasting " applied to a hill is as comparative a term as " holeproof " applied to a stocking. All the great ranges of the present time were elevated in the last epoch of mountain formation, 30 million or so years ago. Their striking relief, as in the steep slopes of the greater Alps, is not due to the original uplift, but to the subsequent carving of valleys by ice and water. A mountain 3,000 metres above the valleys is not something that has been added to the earth's surface ; it is what is left when valleys 3,000 metres deep have been cut in the primitive plateau all round it. This is an effect that denudation can produce in 30 million years. If material is removed from the Alps at the same rate for the same time in the future, the present elevations will be wiped out and the mountains converted into a plain. But the conditions making for rapid denudation will not persist. The rate depends on how fast the streams can carry away the stones, sand, clay, and so on, formed from the rocks broken up, and this rate depends on the velocity of the stream and therefore on the slope of the valley bottom. The longer the mountain system exists, the more its valleys are worn down, and the smaller the amount of material that can be removed per year. The Alps may therefore have a future distinctly longer than their past.

Nevertheless, mountains are greatly reduced in height as time goes on. There is every reason to believe that the Welsh and Scottish mountains were once as high as the present Alps

and that they have been lowered to their present level in the last 250 million years or so. There are even regions, as in the Eastern United States, where the visible rocks show intense folding, but the surface of the land is nearly flat ; a former mountain system has disappeared and left only its traces to remind us of it. The wearing down of the rocks is not the only cause of such a lowering of the surface. A complicated internal movement must go on at the same time, but all we need notice now is that the time needed to wipe out a mountain system is of the order of some hundreds of millions of years. When the cooling of the earth has proceeded to the base of the rocky shell, the interval between consecutive epochs of mountain formation will be of the order of one or two thousand million years. Hence during most of the time there will be no mountains ; one mountain system will have disappeared long before the next is raised. In the quiet periods there will be little relief of the land. Continents and oceans will be very much as at present in outline, but the continents will be so low lying that the streams can carry off little material to the sea. Any matter worn off the low watersheds will be transported only a short way and then deposited again ; there will be no such thing as a muddy river. But there will be an abundance of swamps. The radiation received from the sun will be slightly less than at present, but the general freezing of the ocean will not have begun. Nevertheless, the cooling will probably be enough to freeze the Arctic Ocean ; and if the views of Brooks and Kerner-Marilaun on the cause of climatic variation are correct this will lead to a general secondary lowering of temperature and an extensive glaciation. The ocean will not be frozen at the Equator, but the North Atlantic probably will be, and there will be a great extension of the floating ice about the Antarctic Continent. From that time onwards the amount of ice will increase slowly but surely, and the ocean will become entirely frozen after about a billion years. The reduction of temperature in itself will reduce the rate of evaporation from the sea and therefore the rainfall on the land. This in turn will reduce the rate of denudation, but perhaps not to less than half what it would be otherwise. When a continent reaches freezing-point, however, streams will cease to exist, and the water falling on it, either as rain or snow, will become ice. Ice cannot run off as water does, and a thick, slowly-moving ice-cap will be formed, like the one

that covers the Antarctic Continent at present. Probably Europe, Northern Asia, and North America will be reduced to this state in about 100,000 million years.

Volcanoes will have long since ceased activity. The most probable constitution of the upper crust in the continents is as follows. On top is a sedimentary layer of variable thickness, at most a few kilometres. Below this is a layer of granite about 10 to 15 kilometres thick; below this an intermediate layer about 25 kilometres thick, and below this again a lower layer of dunite, a rare rock at the surface, but prevailing at great depths on account of its high density. The properties of the intermediate layer fit those of a rock called tachylyte. This is basalt, the commonest rock of intrusions, but in a uniform state like a glass instead of a granular crystalline one like ordinary basalt; the difference is one of physical state, not of composition. Granite at the surface is rock that has been formed by fusion of the granitic layer at some depth, and that has forced its way upwards in the liquid state. Basalt similarly has been formed from the intermediate layer. There are several lines of evidence that indicate such a structure, two independent ones based on seismology, one based on the relation between the radioactivities of known rocks and the amount of heat being conducted out of the earth, and others based on mechanical considerations relating to the way continents and mountains are held up. All are consistent with such a structure as has just been outlined. Now the present temperature at the base of the intermediate layer, inferred from the theory of the cooling of the earth, is about 650° C. Of this temperature about 450° are due to the radioactivity of the upper layers, and the rest to original heat. The material is rather fusible in comparison with ordinary basalt, because it contains fusible and volatile constituents that have been lost by the material accessible to us; but some temporary and local source of extra heat is required to produce fusion, otherwise the layer would be permanently liquid, which it is not. But ten thousand years from now most of the radioactive heating will have disappeared; so will the original heat; and there is no reason to suppose the extra heat enough to heat up the intermediate layer to fusion when the chief factors keeping it warm have disappeared. The intermediate layer will become cold, and there will be no more volcanoes. The heat in the lower layer keeps it also in rather a weak state at

present: it is about as strong as brick, whereas dunite when cold is stronger than granite. This weakness has a marked effect in determining the structure of mountains. These are made of the lighter upper rocks, and appear to be floating on the heavy but weak dunite. But when the crust cools the dunite will have its full strength and will no longer give way under the weight of mountains; these will be supported as added loads on a solid layer, instead of like icebergs by the buoyancy of the denser fluid they displace.

The Over-production of Food

R. A. Fisher

The Influence of Malthus

THE doctrine of Malthus, that the welfare of civilised man is jeopardised by an inexorable law to the effect that the population tends inevitably to outgrow the supply of food, has suffered considerable vicissitudes. Malthus' immediate object seems to have been to show that communistic attempts to ameliorate the condition of the poorest class would inevitably defeat their own ends, for the reason that, if they were successful, the removal of the immediate checks of misery and vice would produce an increase of the population beyond the powers of the country to maintain. With a happy knack of mathematical similitude, which seems to have exerted a more powerful effect upon the minds of men than any poetic metaphor, he compared the increase of population to a geometric progression increasing from year to year in a fixed ratio, while the food-supply he compared to an arithmetic progression, increasing each year by a fixed increment ; by boldly extrapolating these curves into the future, it was easy to indicate the date at which the food-supply would be only a half, or a tenth, or a hundredth, of that required ; and he eloquently pictures the miseries of the future population, abruptly confronted with the rigorous consequences of these calculations. To a later generation, impressed by the success of European colonisation in the United States and the British Dominions, in exploiting the untouched resources of the world, and convinced that the free importation of cheaply produced food could be relied upon, at the expense of naval strength and an unaggressive policy, the original doctrine of Malthus might have seemed to be totally refuted by the facts ; for the population increased to two or three times the numbers supported by the home food-supply, and with increasing numbers the standards of living in all classes were materially and progressively improved. Evidently the food-supply had broken away completely from the arithmetical progression, proposed by Malthus as appropriate ; this seemed the major cause of the discrepancy, so that those who did not like to see so pretty a calculation refuted, might look forward still to a time when the waste places of the world should be at last fully exploited

(when, for example, the drainage basins of the Amazon and the Congo should each be supporting a population comparable to that of India or China, instead of less than eight to the square mile), and the geometric progression of human increase should at last catch up with the world's potentialities.

The economic distresses of our own time, and especially the problem of unemployment, seem in recent years to have convinced some of these optimists, not only that the world will in time be over-populated, but that it is so already, at least in patches, and is in urgent danger of being so everywhere. In journalism this school of thought has been ably represented by writers such as Mr. Harold Cox and the Dean of St. Paul's; and a recent book by the late Sir George Knibbs, who, as Commonwealth Statistician in Australia, was responsible for the publication of some of the finest extant bodies of data on vital statistics, shows what a profound anxiety has been produced, even in circles in the best possible position to be well-informed. Sir George Knibbs takes as his text the rate of increase in population of about one per cent. per annum, derived from the census totals of a group of countries between 1906 and 1911. He has no hesitation in applying this rate of increase to the population of the world for the next two hundred years, and with the appalling prospect before him of 15,000 million people on this planet in the year 2169 expresses a natural anxiety about the food-supply. His anxieties might seem to be premature, but he is concerned to impress his readers with their urgency, "The difficulties of the near future relate specially to food supplies and to economic organisation" (p. 15). "It is to be observed that, with the world's growing population, food production difficulties are already coming into evidence" (p. 16).

The writer has had some experience of the scientific aspects of crop production, and a useful acquaintance with the difficulties encountered by oversea agronomists in advising crops and methods of cultivation which shall be economically profitable; consequently, passages like those quoted, especially in conjunction with some of the methods of obtaining increased yields discussed by Sir George Knibbs, and which he says (p. 40) "relieve the outlook for the immediate future," suggested to him that perhaps the boot might be on the other leg, and that the immediate cause for anxiety lay rather in food production outrunning population; at least that some useful light might be shed on the question by considering facts less

open to dispute than that the population of the world would continue to increase at one per cent. per annum, according to calculation.

Economic Symptoms of Over-population

Any sustained tendency for population to outrun the food-supply might on economic grounds be expected to manifest itself by rather clear symptoms. Coming events, as Sir George Knibbs suggests, cast their shadows before them, only instead of inferring a dreadful future from *a priori* considerations, and then starting at *every* shadow, we shall do better to examine impartially exactly what it is that these warnings indicate. The indications that we might easily expect to see of a coming shortage in the world's food-supply are :

(i) A progressive increase in the price of food-stuffs, not necessarily relative to currency or gold, for the general level of prices would be of no guidance in the matter, but certainly relative to the goods or materials from which clothes, houses, and other necessities are made.

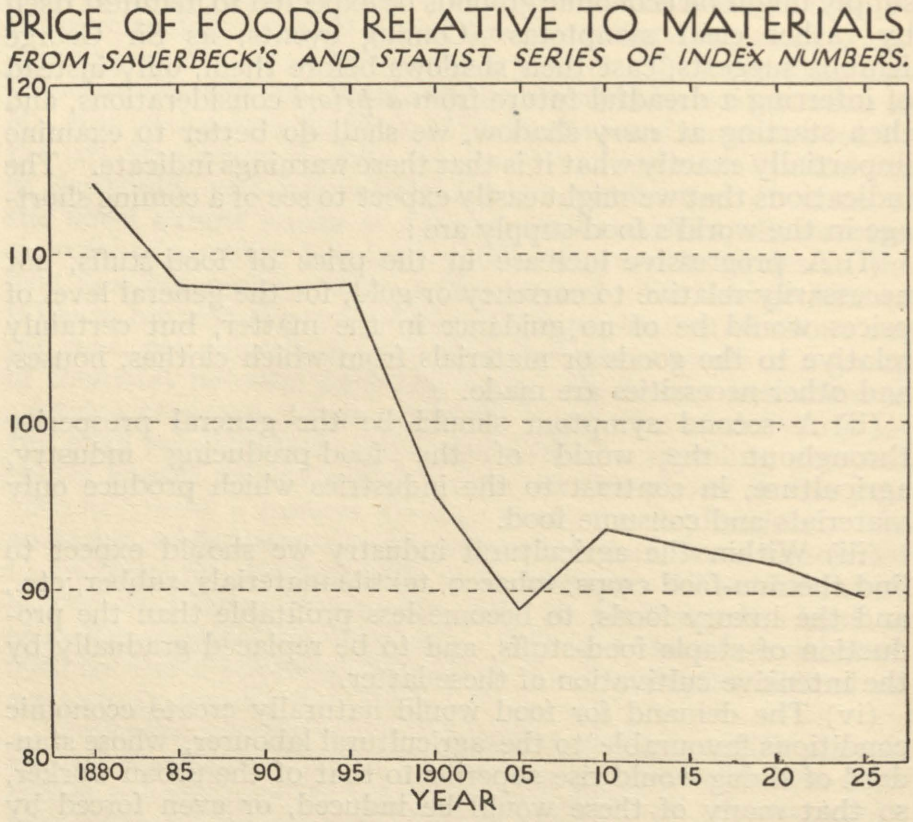
(ii) A second symptom should be the general prosperity throughout the world of the food-producing industry, agriculture, in contrast to the industries which produce only materials and consume food.

(iii) Within the agricultural industry we should expect to find the non-food crops, tobacco, textile materials, rubber, etc., and the luxury foods, to become less profitable than the production of staple food-stuffs, and to be replaced gradually by the intensive cultivation of these latter.

(iv) The demand for food would naturally create economic conditions favourable to the agricultural labourer, whose standard of living would rise superior to that of the urban worker, so that many of these would be induced, or even forced by economic necessity, to acquire the more profitable craft of the agriculturist. In fact, an increasing proportion of the total working population would, especially in the less thickly peopled countries, become engaged in agriculture. Some of these inferences are obviously contrary to current tendencies, and for all there exist some data by which we can examine them. Before he had done so, however, the present writer had no idea how strong the statistical indications were of food-supply outrunning population.

Food Prices

The first point, that of the price-movement of foods relative to materials, may be examined in the excellent series of index numbers initiated by Mr. Sauerbeck and continued to the present time by *The Statist.* In these the prices of a number of standard commodities are expressed in per cent. of the prices at an



arbitrarily fixed epoch, and average price indices are given for foods and for non-food materials separately. The point of immediate importance is the ratio of the price of foods to the price of materials, and this I have calculated for the fifty years ending with 1927. The chart shows the average ratios for the periods of five years each, the first centred at 1880 and the last at 1925. It will be seen that over the last fifty years there has been, not a rise, but a very pronounced fall in the price of food

relative to that of materials, from a value of about 114 in 1880 to about 90 in 1925. The only appreciable rise shown in the chart is from 1905 to 1910, following ten years of exceptionally rapid fall, and followed by fifteen years in which the fall has been gradual but persistent. Remembering that the price of the foods sold has to pay for all the farmer and his men consume in buildings, clothes, and machinery, this chart represents a fact of very formidable importance to agricultural interests throughout the world.

Agricultural Prosperity

At the present time there is no need to stress the fact that British agriculture is not enjoying that era of increasing prosperity which might be anticipated if the world's population were beginning to press upon its food-supply. The depression is acute, and not less dangerous because it is recurrent, and, in the opinion of some, chronic. It is, however, at the present time, not our only depressed industry, and its political impotence in this country might seem to place it in a peculiarly disadvantageous position. In relation to world conditions it is perhaps more important to consider the agricultural situation in the United States. In a recent book, E. S. Mead and B. Ostrolenk describe the American farmers, as a class, as " Forced to a sub-American standard of living comparable to the living conditions from which our Italian and Polish immigrants have escaped." I take this to be an overstatement, but one which would not have been made if the American countryman had not, in fact, a materially lower standard of living than that which prevails in the towns. These authors discuss four methods of ameliorating the situation. The three, which they regard as incapable of affording sufficient relief, are those commonly proposed: the diffusion of knowledge of sound agricultural practice, co-operative marketing and the improvement of distribution, and price-lifting schemes involving state action in the disposal of farm surpluses, together with tariff protection. There remains the automatic method, the economic process of squeezing the less successful producers out of farming and into industry, with diminishing total production, increasing prices, and, finally, prosperity for the remaining efficient producers. The chief obstacle to this programme seems to be the large fraction of the American crop area, which, in the present depressed situation, is unproductive, but which would certainly become pro-

ductive under better prices. To facilitate the transition, industrial education is proposed for the younger generation of farmers about to be forced off the land.

Food v. Other Crops

On the third point, the economic contrast between the production of staple foods, on the one hand, and that of luxury foods and non-food crops on the other, it will be sufficient to remark that the great sources of potential food-supply lie within the tropics, and that the development of these resources would be as feasible as the cultivation of coffee, cotton, or tobacco, if the production of staple foods could be made to pay the expense of European supervision in their development.

The Drift to the Towns

The general movement of population from the country to the towns is due partly to the higher rates of reproduction, which very generally prevail in rural, as compared to urban, districts. To this cause must be added the increasing industrialisation which most populations are now undergoing, in sharp contradiction to the increased expenditure of effort upon food-production, which would be the natural concomitant of an approaching shortage. A mere decrease in the proportion of the population engaged in agriculture, however, is an insufficient statement of the current tendency. In England an actual depopulation of the countryside has been in progress, as is shown by the decrease of the number of men employed in agriculture, from 1,128 thousand in 1881 to 910 thousand in 1921, a difference which is not accounted for by the decreasing acreage available for agriculture. In England, however, this depletion of population in the rural districts is largely, but very unequally, counterbalanced by non-agriculturists who, with improved transport facilities, find it convenient to live in the country, and by former agriculturists who, for the same reason, can carry on their new work from their old homes. The situation in the United States is even more striking, and, in some ways, more serious, for the farm population (a term used for the census population living in farm-houses) has fallen since 1910 from 32,077 thousand to 28,982 thousand in 1925, a reduction of over three million persons in fifteen years. It is doubtful which of these two cases is the more remarkable.

In America we must view it alongside a rapid exploitation of other natual resources, and as taking place in a country where agriculture is politically powerful, and among a people with a strong farming tradition. English agriculture, on the other hand, is adjacent to unlimited markets, which show an increasing demand for the higher class of products, of which in the case of fresh milk it has a virtual monopoly. In neither case could a contraction of agricultural effort have been expected save in very unfavourable economic circumstances.

The four points upon which we have glanced at the existing evidence show conclusively, not only that the idea that the demand for food is tending to exceed the supply is an unwarranted alarm, but that world conditions give cause for considerable anxiety in the opposite direction. To all who have sympathy with the life of the countryman, or admiration for the type of man who can make of such a life a success, it will seem a serious thing that the agriculturist throughout the world should be forced to a lower standard of living, and of culture, than that which a lower level of skill can command in the cities. From another point of view, it is serious that the process of the expansion of our civilisation, over the unreclaimed portions of the earth, should receive a set-back such as it is now experiencing, a set-back in which all commercial and industrial undertakings, built up in the expectation that this expansion would continue unchecked, must also participate. It might be said that the commercial and political framework of the British Empire has been built up upon the confident expectation of such continued expansion, and it is thus of special importance that the British people should form a just appreciation of the present position, and not be misled into regarding their own unemployment problem as a sign of over-population, an easy illusion which can only lead statesmen and people alike to ignore its true causes, and to apply fallacious remedies.

Moral Virtue of Food Production

When considering the causes which have produced the economic unbalance which is the subject of this article it is impossible to disregard a factor of very great antiquity, namely the moral and religious prestige attached to the occupation of producing food. The idea that a special virtue inheres in the food-producing occupations, agriculture and cattle breeding, is at least as old as Zoroastrianism. Its moral prestige in modern

times is well illustrated by the oft quoted ideal of beneficent administration to make two blades of grass grow in place of one. Religious teaching and moral feeling have not, I believe, given such a powerful and consistent urge to other useful services; we should be surprised if we were asked to pray that restaurant waiters should receive divine aid in their work, or that the year should be a favourable one to the insurance companies. This special halo of the food producer, in so far as it adds to the forces favouring over-production, costs him dear, but I doubt if the individual farmer is influenced by it beyond the feeling that he does not like to be producing less than his neighbours. The moral force acts more indirectly through popular sentiment and official policy.

Political Motives

During the nineteenth century the greater part of the world was partitioned among the states of the Western Civilisation. The moral claim that was universally recognised, in the case of territories regarded as suitable for white colonisation, was agricultural occupation. Mere exploitation of minerals counted for much less, whereas the settlement of agriculturists established permanent possession. This supplied a political drive towards the extension of agriculture up to, or beyond, the economic limit. In the partition of Africa the moral claim lay in the effective and orderly administration of native peoples. The warlike tribes, slave-hunters, and nomads must be settled, that is to say they must be constrained to devote their energies to agriculture. In both cases I believe the results to have been eminently desirable, the over-production of food being an accidental, though unfortunate, by-product, the extent of which has been much mitigated by giving agricultural attention to crops other than staple foods.

The Peasant Tradition

It would scarcely have been possible, for motives of high policy, to establish the existing disproportion between the standards of living of rural and urban workers, without the active co-operation of the cultivating class themselves. The motive was supplied by the traditional land hunger of the European countrymen, a powerful force even in England, where perhaps it is weakest. It should be remarked that the rural classes,

during the last three generations, have been producing more than enough children to maintain their own numbers, and perhaps still have a margin to spare in this respect. In consequence, there is not only the widespread rural belief that a countryman's life is the only one for a free and healthy man, a belief in which far more children are brought up than can act upon it, but also a large proportion of the urban population, drawn within the last two generations from the countryside, cherish a traditional and somewhat romantic longing for the independent life of the country. Both classes have therefore shown themselves willing to take uneconomic risks, and to endure the hardships of the pioneering life, in order to achieve a cherished ideal. So long as this margin of uneconomic labour is available, and supported by official policy, so long it would seem certain that rural standards of living must be lower than those earned by work of corresponding skill in the towns.

Cheap Nitrogen

Since about 1850 it has been known that the yields of nearly all farm crops could be largely increased by an artificial supply of fixed nitrogen, and that herein lay the principal value of the ancient practice of making and applying farmyard manures. For a full generation the supply of fixed nitrogen has been recognised as a principal factor in the potential food-supply of the world. Large but limited supplies were gradually developed from two sources, the natural deposits of Chile saltpetre (sodium nitrate) and the ammonia recovered in the production of coal gas and marketed as ammonium sulphate. The latter material had for a long time to fight for its place in the market by selling at a considerably lower price than the Chile saltpetre, which even now it scarcely equals in agricultural reputation. The immense development during, and since, the war of chemical processes for the fixation of atmospheric nitrogen, has opened a new source of nitrogenous manure, which is already more important than the other two combined. The prospect of an unlimited supply, at a low rate, of one of his important raw materials ought, of course, to fill the farmer with joy, and would doubtless do so but for its necessary effects upon the industry of food production as a whole. The economic advantage of cheap nitrogen is only to be reaped by increased production. For various staple crops, the additional return per unit of nitrogen applied is not too inexactly known. It has been calculated that the rate of

increase in the chemical output during the next few years will be more than sufficient to meet the whole increase in world population, without a single new acre being put under cultivation. The calculation is insecure, but seems as likely to be under as over the mark. It raises the question, since further economic depression of the countryman seems scarcely possible, and certainly undesirable, whether the growth of the area under cultivation will not be abruptly arrested, and ought not to be arrested in the interests of existing cultivators.

Failing Population

So far we have only considered the failure of one side of Malthus' argument, namely, that the supply of food has not increased in accordance with the assumed arithmetical progression. A less obvious but, ultimately perhaps, more important departure from the expectation of the theory, has occurred on the behaviour of the human population. In Malthus' view this should have increased in a geometric progression, and, with a higher standard of living, the logarithmic rate of increase should itself have increased. A general rise in the standard of living has occurred, evidently due to the greatly increased efficiency of social co-operation, in industrial processes and transport. In particular, a superabundant food-supply has been developed, by the rapid settlement of new agricultural territory. In the meanwhile the growth-rate of those populations for which accurate data is available has not increased, or remained stationary, but has, gradually at first and then rapidly, diminished, over the period during which the relative price of food-stuffs was still falling and the standard of living still rising.

Over the area comprised by France, Switzerland, Germany, Great Britain, and the rest of Northern and Western Europe, a recent study by Mr. R. R. Kuczynski has shown by a comparative examination of the rates of death and reproduction, that the period of population increase in this area, as a whole, has already ceased. Some of the smaller and more rural countries, such as Denmark and Finland, were still, in 1927, producing slightly more children than would be needed to maintain a stationary population ; and the same is probably true of certain rural areas in the larger countries. The area as a whole, however, is producing, according to Kuczynski's calculations, only 93 per cent. of the number of children which

would be produced by a population which was just maintaining its numbers. It should be explained that such estimates are concerned with the actual present behaviour of the populations considered, in respect to reproduction and death ; and that the impression given by successive census totals is deceptive, not because these are affected by immigrants and emigrants, but because, owing to the longevity of man, the census total will continue to increase for several decades after a biological decrease has already set in. The older age groups take little or no part in reproduction, and their death-rates, which control the numbers which ultimately accumulate at these ages, make no difference to the supply of future children. The cycle from birth to birth is completed, with women, for the most part in less than 30 years, and, in the area considered, the younger age groups are already diminishing before the past increase has had time to take effect in filling up the older age groups.

The tendency, which is very pronounced in Northern and Western Europe, where the births are not only insufficient to maintain a stationary population, but are still falling, more rapidly, apparently, than ever, is certainly not confined to that region. An equally striking fall in natality is evident in the United States and in the British Oversea Dominions. The promised extension of Kuczynski's comparative researches to these regions will be of particular interest, for, though it seems improbable at present that biological increase should already have ceased, the rate of fall, in comparison with the existing margin, should give a useful indication of the answer to the question for how long any real increase is to be expected. By the analogy of the rapidity of the European fall, a single decade will perhaps wipe out the whole of the margin of increase.

Economic Bonus to the Childless

There is, at the present time, little room to doubt that the diminution of births in the white race throughout the world is due to the voluntary prevention of conception, actuated principally, but not exclusively, by economic motives. The economic motive is a very considerable one. Throughout the whole range of income represented by wages and salaries, the economic cost of a child can never be far from about 12 per cent. of the total income of a childless couple of the same economic standard of living. A couple with four dependent children, earning sixty shillings a week, can afford, as nearly as can be

judged, the same quantity and quality of food, clothes, housing, and amusements, as a childless couple earning forty shillings a week. Equally, a childless couple with £800 a year can afford nearly the same individual consumption of goods and services as a couple with four dependent children earning £1,200 a year. This economic burden of children, during a period in which the knowledge and availability of contraceptive appliances has very greatly increased, is apparently sufficient to explain the very large and widespread fall of the birth-rate.

It should be noted that the range of income from the lowest current wages to the highest available salaries has an important economic function to perform, in inducing individuals to qualify themselves, at the cost of personal efforts and expenditure, to render, as far as they are able, valuable services to the community. An extreme communist, but only an extreme communist, will refuse to admit that the prospect of economic advantage is, in fact, a powerful incentive to the exercise of care and diligence by employees. Even an extreme communist, however, will not deny the necessity of supplying an economic recompense for the expenditure that a man has incurred, in general education, or special training, in order to fit himself to perform services of particular value. The system of differential wages or salaries may thus be regarded as a means by which the community, either directly or through a private employer, purchases the exercise of care and energy, the efforts towards self-improvement, and the educational advantages which fit men to be of value in the society to which they belong. This economic function of differential rates of pay is fundamental in all considerations of possible modifications of our wage system.

The economic inducement offered to the individual consists, of course, not in the currency tokens, in which he is paid, but in the standard of living which he can procure for them, including in that term the deferred satisfaction represented by savings. It is obvious that, in the system of wages and salaries current in this country, this standard of living depends partly on the value of services performed and partly upon the absence or paucity of dependent children. Society, in fact, is using the wage system, inadvertently, not only to purchase valuable social services from its citizens, but also to purchase their relative or absolute childlessness. Reckoned in the realities represented by the standard of living, Society gives extra pay to energy, care, trained competence, and the absence of children.

It cannot be denied that the inclusion of the last item does detract somewhat both from the economic efficiency and from the economic justification of the system of differential wages. If an insurance company were to employ a salary scale of £200 to £3,000 a year to secure actuaries of high competence and efficiency, they would be wise to apply the grades of salary available in accordance with the professional qualifications, experience, and capacity of the men employed. We should think the directors ill-advised if they resolved that, while they preferred efficient actuaries and were willing to reward efficiency, yet they also preferred their actuaries to be fair-haired, and would henceforth pay their fair- and dark-haired employees in the ratio of 3 to 2. In doing this, they would doubtless secure the services of a certain number of, naturally or artificially, fair-haired actuaries, who were competent in their profession. They would certainly increase the proportion of the fair-haired among their employees ; but it is evident that they would also diminish in some measure the average level of actuarial competence. They would, in fact, be enabled to buy somewhat less competence than they could have procured had they devoted their resources entirely to that end, and not at the same time devoted their salary system to purchasing a further amenity, which, however desirable in itself, was not actuarial competence.

The analogy of a demented insurance company will suffice to make clear the purely economic point, that in giving, through the wages system, a bonus to childlessness, we are not procuring that commodity for nothing. We are buying childlessness in the same market as we are buying the competence, and other qualities, needed to produce wealth, and buying it in such a peculiar and inadvertent manner that we have no control even over the quantity or quality of the childlessness supplied. We do not vary our terms according to the abundance of the supply, and since the terms are high it is not surprising that the supply has increased beyond the bounds of any reasonable policy. The birth-rate, as is well known, has been falling in this country for nearly sixty years ; it is less widely realised that for over twenty-five years the actual number of the annual contingent of babies has been diminishing, gradually and irregularly at first but latterly at the high rate of 3 or 4 per cent. annually. In consequence the school children are already decreasing at all ages, while according to Professor Bowley's estimate the number

of women of reproductive age will pass its maximum about 1931. In relation to the births needed to maintain a stationary population Kuczynski estimates the actual numbers to be, for England, 88 per cent. in 1926 and 82 per cent. in 1927. The comparison of these two figures exaggerates, I believe, the rate of fall, for 1927 is evidently a low year, and 1928 may well be no lower. There can be no doubt, however, that the population is not only failing by a rather wide margin to reproduce its own numbers, but that it may be expected to fail even more conspicuously to do so for some years to come.

In respect of quality the peculiarity of our current method of favouring childlessness is that we pay the highest economic equivalent for the worst quality of childlessness, or in other words for buying off the best quality of children. A professional man earning £1,200 to £1,500 a year is about £150 a year better off for each child that is not born ; an unskilled labourer receives an inducement equivalent to about 5*s.* a week. If he is largely unemployed, or in receipt of outdoor relief, the inducement is less ; while, to those totally dependent upon Society for their maintenance, we make no offer at all to induce them to refrain from procreation. If we turn to consider how much childlessness is worth to the Society which is at such pains to procure it, it is evident that it is worth exactly the economic debit balance of the whole life-history of the hypothetical child. For all who pull their own weight, and produce wealth or social services more than equivalent to what they consume, there is no such debit balance ; Society is better off for their existence. There will, however, be many, in all societies, who fail to pull their weight, and the birth of these might with advantage be bought off. In the important class of habitual ne'er-do-weels I should suggest, indeed, that, since they are already indebted to the State for the benefits they receive under the Poor Law, to an amount which they cannot otherwise repay, childlessness provides a partial recompense which is, or should be, within their power.

Prospects of Population Recovery

It will be obvious to the reader that I consider the present a bad time to go into the market to procure childlessness, at any price ; and that, when it does again become necessary to encourage the supply of this commodity, very different methods should be employed from those of the past. The present is a

bad time, because lack of population has already given a sharp check to world development, including to an important extent the development of the British Empire ; because the economic conditions in respect of food-supply are particularly favourable to population growth ; and because without such growth it will become increasingly difficult to maintain that continuity of world development, which alone can justify the political predominance of the Western peoples. The production of useful citizens is taxed like a superfluous luxury, whereas, economically speaking, wealth devoted to this end should be regarded as savings, and as productive investment, of which society as a whole reaps the benefit. If we can imagine the economic bonus on childlessness to be totally abolished at a blow, in respect of all in receipt of wages or salaries, that is to say, if we imagine a system of family allowances, paid out of proportional wage deductions, to employees of all ranks, and of amount equivalent to the actual economic burden of their children, we might reasonably look forward to a certain slow recovery in natality. There are among the French associations, some paying allowances on a scale more than sufficient for children after the fourth, and substantial for the earlier children. The records of these show an increasing proportion of dependent children to employees ; but this increase is found, upon examination, to be due to the larger families seeking employment where they will be well supported, and there is no detectable sign, in the records of the first six years, of any increase of natality. We may, indeed, have to wait until the children benefited have married, before an appreciable response is obtained. Possibly, again, the example of the better paid classes, for whom the French system makes no adequate provision, is responsible for the failure of the allowances to produce more births. The English birth-rate is already considerably lower than the French ; it is also falling much more rapidly. It will be some years before it can be brought to a standstill by any economic relief. A further period would be needed before it recovers to its present low level, and a third period must elapse if it were still to continue to rise, before it could become sufficient to maintain a stationary population. A man of forty would seem to me very optimistic if he expected to live to see the peoples of England and Scotland again maintaining their numbers, even if it were immediately possible to abolish entirely the economic bonus to childlessness, inherent in the present wage system.

In considering the future course of population increase or decrease, it has been necessary to touch upon the system of family allowances, because this system is the only agency which seems at all capable of checking the present tendency of many European peoples to decline in numbers ; although its power of doing so must still be regarded as doubtful, and, if effective, its action will certainly be slow. It would be quite beyond the scope of the present article to consider the other two aspects of this proposal which deserve the closest attention, and upon which its merits ought, finally, to be judged. These are, on the one hand, its efficacy, to be best judged by the French experience, in combating poverty and allaying industrial discontent ; and, on the other hand, the question of even greater importance, which it raises, as to its effects upon the hereditary constitution of future generations. These, which are certainly intricate, ought above all to be fully explored ; and it is a matter for regret, though not perhaps for surprise, that the Eugenics Society in this country has not as yet formed a decisive opinion upon the question.

The Shadow of the World's Future. Sir G. H. Knibbs, C.M.G., F.R.A.S. (Ernest Benn, London, 1928.)

Harvey Baum : A Study of the Agricultural Revolution. E. S. Mead and B. Ostrolenk. (University of Pennsylvania Press, Philadelphia, 1928.)

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A Dynamic Technical Museum

WALDEMAR KAEMPFFERT

STRUCK by the popularity of European technical museums, Mr. Julius Rosenwald three years ago decided to establish in Chicago not merely an imitation, but an institution which would utilise the experience of Europe as a foundation. He laid his plan before a group of representative business men, and expressed his willingness to endow an American technical museum with the sum of $3,000,000 to be spent for equipment alone. As a result of the interest thus aroused, the community took immediate action. The South Park Commissioners issued bonds to the value of $5,000,000 for the purpose of providing a suitable structure in stone, steel, and cement. By 1932 it is hoped that the Rosenwald Industrial Museum will be open to the public. Already $500,000 worth of exhibits have been donated without solicitation by railways, public utility companies, and manufacturing companies—the nucleus of a collection which is destined to trace the technical ascent of man from prehistoric times to our own. In addition to exhibition halls the Museum will have at least three auditoriums ranging in seating capacity from 200 to 1,500, as well as smaller rooms in which the sections of scientific societies will meet.

In the technical museums of Europe, wheels move, valves seat and unseat themselves, meshing gears cause large masses to rise and fall rhythmically almost under the conditions that prevail in a factory. Everywhere there are push-buttons, crank-handles, and levers that the curious may manipulate and thus start and stop the smaller models. The museums are alive.

Similarly, historic locomotives will pant in the Rosenwald Industrial Museum as they panted a century ago to show how mechanical transportation on rails began, and the beams of Newcomen engines will rock to show how cumbrously and inefficiently steam was applied before Watt's time. The chasm between these obsolete titans and the modern silent, completely encased steam-turbine will be bridged by moving reproductions of the inventions of Watt, Hornblower, Corliss, and Parsons. Edison's Pearl Street power plant in New York will also be there in miniature—the first of the central stations that ushered

in the electrical era of industry. And so will the telegraphs, telephone, radio-signalling devices, telescopes, ploughs, harvesters, and the thousands of inventions without which modern civilisation would seem empty.

But the sponsors of the Rosenwald Industrial Museum have reached the conclusion that the time has come when a forward step must be taken. On the experience acquired by Munich, Paris, and London, an institution is to be reared that has no exact counterpart anywhere, despite the outward similarity that it will bear to the technical museums of Europe. And this forward step is to be taken by presenting not only machines in motion, but also by illuminating the social phases and cultural aspects of science and technology.

Scientific principles and inventions are discovered and made to be utilised. What do they mean in our lives? It is this question that the Rosenwald Industrial Museum intends to answer, as well as to explain science and industry technologically. Herbert Spencer first pointed out that instruments and machines are but extensions of the human organs, and it is thus that many of them must be interpreted if their social significance is to be fully grasped. What is a steam-actuated, orange-peel bucket but a huge steel hand which clutches five tons of ore or coal instead of five ounces? What is any gantry crane but a gigantic system of steel muscles controlled by the living brain and the hand of an intelligent workman whose chief exertion is the closing and opening of a switch? Telescopes and microscopes —what are they but amplifications of the human eye? The historian Fairgreave has driven home the social meaning of these extensions of the human body by strikingly contrasting the society of ancient Greece with that of New York and of Chicago or London in terms of man-power. In the time of Pericles a Greek freeman commanded the services of five helots, or slaves—the equivalent of about half a horse-power; and the best grain mill in the hey-day of Athens produced roughly the equivalent of five barrels of flour a day. The average free-born American of our time has at least sixty slaves at his beck and call in the form of machines. In a steel mill he may control ten thousand horse-power. Brains have become more important than muscles. Sweep away these automata and the United States alone would have to support a population at least sixty times greater than it is, if the average American is to maintain himself in what he has come to consider economic decency and

comfort. Thus we are enabled to picture in imagination the social and economic consequences that have attended the introduction and evolution of industrial processes. And thus it is that the Rosenwald Industrial Museum will undertake to interpret the machine.

The population, mostly slaves, that Western countries would have to sustain to produce with man-power alone the goods now consumed, raises a question. How would these human swarms be fed ? And that in turn makes us consider how the civilised world feeds itself to-day, numerically stronger now than it ever was. The truth is that even the nations of this machine-age would starve were it not for the aid of science and engineering —starve for lack of chemical fertilisers and mechanical ploughs, sowers and reapers, for lack of steamships and railway trains, for lack of methods whereby foods may be preserved so that the plenty of fat years may be enjoyed in the lean. So the thousands of visitors who will pass in and out of the Rosenwald Museum in the course of a month will acquire a vivid sense of what engineering and natural resources mean in their own lives. The harvester and reaper, locomotives and steamships, will cease to be merely ingenious combinations of machine elements and become saviours of the human race.

Intimately connected with this feeding of the world is the problem of keeping it in health—of staving off disease. The introduction of the steam-engine gave us the factory and mass production, and the steam-engine in turn made it necessary to huddle masses of humanity in industrial centres. Social problems were presented which could be solved only by science. Without its aid tuberculosis and typhoid fever would make it impossible to house workers decently or to provide them with the clean, well-lighted factories and offices in which they now work. The bacteriologist and the sanitary engineer are doctors of civilisation. Water-pipes and drainage systems, stepped-back sky-scrapers and smoke-consumers, will therefore appear in that section of the Rosenwald Industrial Museum which will be devoted to the evolution of the city, not alone as interesting applications of science, but as the means whereby an industrial society is enabled to work and clothe and feed itself without committing suicide.

As soon as the social implications of science, engineering, and industry are thus developed, the museum visitor realises that the nature of technological research is often determined by the

conditions under which men live. Even those who know something of the history of technology are not all aware that as early as the reign of Queen Elizabeth England's forests had been hewn down, and that Englishmen were often dependent on coal as a household and industrial fuel. The mines, mere open pits for the most part, were drowned, and the horse-pumps of the time were unable to drain them. By the early eighteenth century the situation was critical. A great invention, some mechanical substitute for the horse, was needed. The economic pressure acted on the brains of dozens, perhaps hundreds, of engineers for at least a century. Two engineers, Newcomen and Savery, proved equal to the task of devising a steam-pump which would surpass the horse as an engine.

Surely it becomes a duty of the part of the Rosenwald Industrial Museum to dramatise the story of this social and economic pressure. But how? The methods are various. Imagine a diorama in which as many as 500 horses are shown hopelessly struggling with the rising water of a drowned mine. In the neighbourhood smithies and primitive workshops stand idle for lack of fuel, and peasants shiver in their huts. Imagine, too, a suitably worded label which will amplify what little is not self-evident in this staging of England's plight. Perhaps a few statistics may also be required to drive home the full significance of the scene, especially for the university student of economics. We picture a crisis, a situation which can be surmounted only by a highly inventive engineer. We are then ready to study the surmounting means—the Newcomen-Savery engine, in which steam is crudely and wastefully condensed within the cylinder itself by means of cold water, so that atmospheric pressure can drive the piston down.

The next step is, of course, the invention of the separate condenser by James Watt, instrument maker to the University of Glasgow. His technical and social relation to the past is now clear. We see at once how utterly impossible it was for him to have given the world the steam-engine that bears his name without the structure of Newcomen and Savery to build upon. Then follows the most extraordinary social and economic transformation that the world has ever seen—what economists call the "industrial revolution." The Museum will depict what it meant to place mechanical energy at the disposal of industry. Coal becomes an even more precious natural resource. Henceforth it is energy. The visitor who leaves the Museum will

come away with the impression that James Watt was something more than a great inventor—that he did more to transform the face of the earth and mould social institutions than Alexander the Great, Julius Cæsar, and Napoleon Bonaparte, and that history is made in the laboratory and workshop as well as on the battlefield.

When we thus consider the social implications of the engineer's work, the real meaning of this dawning electrical age becomes apparent. To be sure, the rise of electricity from Thales must be traced technically if for no other reason than to show that for centuries electricity was of no social and economic importance. There will probably be a reproduction of a corner of the famous laboratory in which Sir Humphrey Davy and Michael Faraday conducted their classic researches, and the visitor will perhaps imagine that he is himself Faraday when he performs the very experiments that enabled the greatest of experimentors to lay the foundations of modern electrical engineering. A new social world will be revealed to him when the visitor sees what Faraday, Wheatstone, Morse, Bell, Edison, Siemens, and Marconi accomplished with discoveries that seemed to have but a purely scientific value at the time that they were made. Energy is no longer localised by coal. It is shot hither and thither along wires and flashed through empty space itself. The visitor will understand the significance of the transition period through which we are now passing, a period in which electrical energy generated by twenty and even fifty central stations located in a dozen states is pooled to form a great invisible reservoir which may be tapped at will, so that an excess in one city may make good a deficiency in another. Three-dimensional models, some of which will move incessantly, will make it clear to him that he is living in an electrical transition period, and that, like James Watt, the electrical engineer is moulding society and rearranging the economic structure.

One after another the great inventions and discoveries will thus be taken up, first to be explained technically, and then to be socially and economically integrated with their time. Hence we must not be content with a working model of the first Otis elevator. We must also show how that elevator made possible the cities that we know, cities with structures towering to heights that seemed incredible fifty years ago. Certainly the Museum must present the social problems that the skyscraper, the direct

result of the elevator, has created—present, for example, the spectacle of fifteen and even twenty thousand people, the population of a small town, discharged from a single American office building upon the street at the end of a working day, and then connect these hordes with elevated railways, subways, trams, and omnibuses. In other words, the elevator, the tall office building, hotel and apartment house, subways and street-railways are socially related to one another, and this organic relationship must be brought out in the Rosenwald Industrial Museum by models, paintings, motion pictures, and dioramas.

One of the most interesting halls will be that devoted to current phases of science and technology. Of late we have heard much of the English Channel Tunnel, for example. Few engineers will deny the feasibility of stepping on a train in London, of travelling under the Channel at a speed of sixty miles an hour, and alighting in Paris a few hours later. If the Rosenwald Industrial Museum were now in existence, there would be a model of that tunnel in the hall devoted to Concepts of the Day, so that Chicago may see how the engineer would make intercourse between France and England easier. The problem of utilising the water of the Great Lakes is now a matter of national and municipal concern. Were the Museum in existence to-day, a model would reveal the exact nature of the problem and also the more feasible solutions—reveal both with the aid of actual water in a miniature lake. In a word, that special hall will be a place where the news of technology will be concretely expressed in models.

In a museum which addresses itself to the task of interpreting technology, socially the scientist, engineer, or inventor will cease to be the familiar "wizard" of the newspapers, and will assume a new but less deceptive glamour. His indebtedness to tradition and to the stimulus of his time will become apparent. His genius will never be questioned, but the technical heritage of the race will be correctly appreciated. The public will see for itself that motion pictures, radio broadcasting, and television are the products of a long evolution; for the individual steps will be displayed in the museum. As he wanders literally through centuries of human technical and social progress in the Rosenwald Industrial Museum, as he sees how the technical mind has developed such remarkable primitive inventions as the wheel and the sail, the visitor will realise how much great scientists, engineers, and inventors owe to the sheer momentum

of the past. He will also see how one science has borrowed from another, how the metallurgist, for example, has imbibed the principles of chemistry until he has become a chemist himself, how the laws of Newton, once regarded as purely theoretical expressions of relationships of masses to one another, have become the foundation-stones of physics and engineering. Hence the labels that will be affixed to the exhibits, to give dates and to place the inventions where they belong in what patent lawyers call " the state of the art," will probably never hail any inventor as the " first " in his field.

The matter of awarding credit where credit is due becomes all the more difficult when we reach our own day. Organised research has become as essential an activity of industry as manufacturing and selling. Technical progress, no longer spasmodic and haphazard, is systematic and even predictable. The lone, heroic inventor probably belongs to the past. His place has been taken by groups of research physicists, chemists, and engineers directed by a great leader in an industrial laboratory. Technical achievements are therefore rapidly becoming anonymous because they cannot be credited to a single, towering genius. It becomes the task of the Rosenwald Industrial Museum not only to exhibit what has been invented in the past and in the present, but also to explain how it was invented, and to account for the velocity of the technical progress of our own time.

Every museum of to-day is primarily an educational institution. Hence museum technique has been profoundly affected by improvements in teaching methods. The successful teacher is usually he whose presentations are most vivid. Both the classroom and the museum are livelier and more interesting than they were fifty years ago. The dramatic is introduced not for its own sake, but as a means to an educational end, and this is as it should be, because it is the primary function of the drama to interpret life. Since the Rosenwald Industrial Museum will explain not only the operative principles of the machines, but the relation of the machines to life, it follows that it must count upon dramatic efforts to achieve its purpose, but this without becoming theatrical.

Let us take the road, for example. It is not enough to show how the Appian Way was built or what were the technical methods that made the roads of Macadam and Telford what they were and still are. We must contrast the smooth, hard

road of to-day with the knee-deep mud through which our forefathers ploughed their way. Read this from Macaulay's *History of England* :

> " The great route through Wales to Holyhead was in such a state that, in 1685, a viceroy, going to Ireland, was five hours in travelling fourteen miles, from Saint Asaph to Conway. Between Conway and Beumarais he was forced to walk a great part of the way ; and his lady was carried in a litter. His coach was, with much difficulty, and by the help of many hands, brought after him entire. In general, carriages were taken to pieces at Conway, and borne on the shoulders of stout Welsh peasants to the Menai Straits. In some parts of Kent and Sussex, none but the strongest horses could, in winter, get through the bog, in which, at every step, they sank deep."

Add to this Lardner's statement that before the days of good roads and railways the charge for carriage by wagon between London and Leeds was at the rate of £11 to £12 a ton, and we have material enough for an exhibit which will show how manufacturing was hampered and why such heavy materials as coal " could be available for commerce only where their position favoured transport by sea." It is easy enough to imagine a diorama which will explain the difficulties of trading two hundred years ago and prepare the visitor for the railway and the enormous part that it played in the national and international growth of manufactures and the distributors of goods.

When it comes to tracing the evolution of railway rolling-stock, the Museum will be faced with a difficulty. The policy of exhibiting full-sized machines has proved to be the best in Europe. Yet, despite its 400,000 square feet of floor space, the Rosenwald Industrial Museum is not large enough to contain a full-sized reproduction of every important railway vehicle, from the first carriage which was hauled on the Stockton and Darlington Railroad over a hundred years ago, and which bears all the evidence of its horse ancestry, to the modern steel Pullman. So time and space must be telescoped. A carriage will be constructed which will be divided into periods. In the first compartment you may seat yourself, and experience all the sensations of bumping over the poorly ballasted and none-

too-well-laid rail of the 'forties; for that compartment will be mechanically shaken to impart the realities of a railway journey in the days of our grandfathers. As you look out of the window you see the landscape of the time—a realistic painting, ingeniously illuminated, travelling endlessly on rollers. The last compartment will be that of a modern sleeping carriage. Its motion will be hardly perceptible, and from the windows the painted skyscrapers of Chicago will be visible.

It is likewise impossible to trace the development of pavements, water supply, and sewage disposal with full-sized reproductions of streets. And so there will be a street which will be a hundred feet long and which will be divided into periods of time. In two minutes the visitor will walk from the seventeenth century to the twentieth. He will see a gentleman of Elizabethan London carried in a chair through the mud with link-boys to light him home; he will note the absence of an adequate water supply and a drainage system. As he steps into the next division it will strike him that oil lamps illuminate the darkness and that footway and carriageway have improved. And so, as he walks on, he will be impressed with the change wrought by the introduction of gas and electricity, of water and sewer mains and of houses, all bearing an obvious technical relation to the improvements of the street. Finally he enters a few feet of a modern avenue, with shop windows and streets brilliantly illuminated, with hard, smooth asphalt beneath his feet, and a roadway honeycombed with conduits for cables that deliver energy or convey messages.

The cinematograph plays a minor rôle in European museums, partly for lack of funds, and partly for lack of a sturdy, faultless daylight projector. In the Rosenwald Industrial Museum scores of projectors will be found, operated for the most part by push-buttons. It will be their function to clarify the obscurities of the electron theory, induction, relativity, and the wheeling of the planets. With their aid the public will be photographically transported into steel mills and factories to learn how the principles elucidated by moving models have been there industrially applied. Some of the films will talk in sound-proof booths and thus relieve attendants of much lecturing.

The wax mannikin is still inevitable. Yet the experiment will be made, at first on a small scale because of the expense involved, of substituting here and there living flesh and blood

for wax. If we are to show how life has been affected by machines, it should be with the aid of life itself. In a large auditorium in which distinguished sociologists, economists, scientists, and engineers will deliver popular lectures, an opportunity will be presented to test the possibilities of this innovation in museum technique. If a distinguished anthropologist lectures on primitive inventions, he will be assisted, if need be, by skilled and suitably costumed pantomimists, who, amid proper surroundings, will live over again the precarious lives led by huntsmen forty thousand years ago or give us a vivid glimpse of what existence must have been among the Swiss pile-dwellers.

The need of an educational institution such as the Rosenwald Industrial Museum is apparent. Science, engineering, and industry are so complex in their interrelationship that it is difficult to grasp the significance of their rapid progress. Time was when even those who were not themselves artisans had at least an elementary knowledge of the leading arts and crafts. In this day of the automobile few of the younger generation have ever seen the process of its manufacture. Baking and laundering are now the business of great companies who have reduced them to chemical control. Houses in America are of necessity still built in the open, but the window frames and posts are delivered ready made from the mill, so that the carpenter does little sawing and planing and is reduced to the status of an assembler of delivered lumber. Nearly all metal is fashioned in distant steel mills, and as a consequence only engineers actually know how rails, girders, and other structural shapes are produced. The factory and the machine have so far usurped the place of the oldtime craftsman that nearly all technical processes, from the making of a tin-whistle to the building of a locomotive, are now carried on with the aid of massive machines, which are mysteries because they are rarely seen by the public. The enormous influence that the scientist has had on industry is but vaguely understood. As for the social effects that follow the introduction of new machines and processes, we are aware of them, but we do not grasp their deep significance.

The principles of science are not yet the possession of the many, even though the age is essentially scientific, and the effect of scientific research, invention, and industrial progress is felt rather than understood. There is no lack of interest in

technology, as the small crowds testify that are fascinated by the stiff but efficient movements of a steam-shovel excavating a huge hole on the site of some future office building. But the people have no opportunity to gratify that interest, no opportunity to survey the technical and social progress of the past and evaluate the status of the present. And it is the primary purpose of the Rosenwald Industrial Museum to create that opportunity.

The Social Life of the Primates

S. Zuckerman

UNTIL recently, the study of animal psychology was pursued mainly in order to obtain evidence supporting the Darwinian hypothesis by demonstrating mental continuity between the animal and human worlds. Its point of view, however, was anthropomorphic, and its extravagant exposition provided some animals with an intelligence little less than human and many with a code of morals which would have sustained them in any civilised community. From this plight it was rescued at the beginning of the present century, and to-day the study of animal behaviour is one of the more stimulating and useful branches of psychology. On the other hand, animal sociology stands to-day where animal psychology stood thirty years ago. Its method is still mainly anthropomorphic description, either in the older blatant form or in a new guise, provided with a crude behaviouristic formula which explains all behaviour as the product of an instinctive nucleus and experience. In the hands of its exponents animals share with man a common classificatory scheme of social conduct. However sound this formula may be, one can see in it no justification for such purely speculative assumptions as that made by Alverdes in maintaining that human monogamy and the monogamy of birds are comparable, and can be discussed in identical terms.

In spite of the obvious mental continuity between the animal and human world, and though the human mind and animal mind are plainly different in degree only, one cannot emphasise sufficiently the importance of the gap set up by the presence in the human world of articulate speech and other symbolic processes. Man's traditional and material culture are almost insuperable obstacles in the way of the direct comparison of human and animal behaviour. The animal has but to search for food and mates and to avoid his enemies, and so far as possible effects these in a direct manner; but in the multiplicity of human endeavour these ends become almost completely disguised. Forms of behaviour which in the animal world are often directly referable to physiological causes cannot be compared with similar forms of human behaviour, the immediate causes of which are in most cases as yet un-

determined ; for there is hardly any sphere of human activity not conditioned by culture. The human infant from its very beginning is influenced by its family, and its wider heritage, social tradition.

As a rule, too, exponents of animal sociology are primarily concerned with problems of human sociology. Consequently they do not study the social activities of animals in an unbiased manner. As a result, it is not surprising to find, for instance, that from the same evidence one author concludes that the anthropoid ape lives permanently in a family consisting of male, female, and young, while another argues that the male is a roving animal who mates promiscuously with any female. Another frequent outcome of such treatment is a broad generalisation extended to all animals. The fish, the reptile, the bird, the mammal, are all brought together under the same scheme of social behaviour, irrespective of the vast differences prevailing between them. Such a method is obviously inadequate. There can be but one safe approach to a study of animal sociology. Each class of animals must be considered according to its own characteristics, morphological and environmental. Birds, on one line of evolution, cannot be classed with mammals on another, and even mammals cannot be considered to represent a homogeneous group. It is only through such a specialised approach that the study of animal life will free itself from anthropomorphic tendencies. Unfortunately, owing to limitations of size imposed upon an article such as this, it is necessary, in order to bring out here the specific features of infrahuman Primate Society, to indulge in generalisations at the expense of the rest of the mammalian order. It must be understood, however, that such generalisations cannot include the characteristics of all sub-primate mammals, and that they represent only a partial and by no means adequate sketch.

The sexual activity of almost all mammals in a state of nature is restricted to certain well-defined seasons, and during the rest of the year is in complete abeyance. The period during which the animal is completely asexual is known as the anœstrus, the essential physiological characteristic of which is the complete cessation of all forms of sexual and reproductive activity.

Almost all the evidence, observational and experimental, indicates that the various Primates, the monkeys and apes, differ from other mammals in that they have no clearly marked

anœstrus. Many species are said to breed in a state of nature throughout the year, and in all parts of the world captive monkeys breed at any time, if they breed at all. It is probable, however, that actual reproduction in some species, for instance two Indian monkeys, the Rhesus macaque and the Entellus langur, is limited to certain seasons of the year. Nevertheless, it is almost certain that even in such species the reproductive organs are never completely quiescent, as are those of the lower mammal during the anœstrus. Moreover, observations indicate clearly that the monkey continually manifests sexual behaviour. This distinction between Primates and other mammals is of fundamental importance sociologically. For, on the strength of it, one would suggest that mammals can be divided into two main groups: the first, including mammals with an anœstrus and demarcated mating seasons, limiting both physiological activity of the reproductive organs and sexual behaviour; the second, comprising the Primates, whose reproductive organs are never completely quiescent, and who continually exhibit sexual behaviour, there being no anœstrus. All Primates that have been investigated fall into this second class, but there are several, for instance the New World monkeys, about whose reproductive activity almost nothing is known.

It is necessary to obtain some idea of behaviour in the first group of mammals, before attempting to understand the Primate.

Mammals belonging to this sub-primate group spend the anœstrus in a variety of ways. Some, like the jaguar and lion, live a solitary life. Others, for instance seals and buffaloes, live in separate male and female herds—these latter known as "mother herds." Another group can be recognised, including the porcupine and rabbit, in which both sexes live together without any significance arising from anatomical distinctions of sex. Lastly, it is also said that some polygynous mammals like the kangaroo and wild horse continue to associate in harems after the mating season. In the majority of mammalian species, however, the sexes separate.

It is important to recognise clearly that any associations of the two sexes during the anœstrus are, so to speak, asexual associations. This unfortunately is usually overlooked, and one hears of permanent monogamy or permanent polygyny occurring in this group of mammals. These animals, however,

do not manifest any form of sexual behaviour during the anœstrus, and it is idle to imagine that any specific relationship prevails between the sexes during this period. The idea of permanent sexual associations conflicts absolutely with the seasonal transition of a sexual animal with functional reproductive organs, and manifesting sexual behaviour, into an asexual animal with non-functioning reproductive organs, exhibiting no type of sexual response. It is as though one animal were transformed into another. This seasonal alternation from sexual to completely asexual behaviour is quite outside the range of human experience. Anœstrous associations are as a rule concerned with purposes of defence or offence. They are not primarily a means of keeping the sexes together. With all mammals except the Primates the family consists of mother and young only.

The character of the anœstrous mammal and the nature of anœstrous associations changes completely as the breeding season approaches. Reproductive organs become sexually active, the metabolic rate quickens, manifesting itself in a variety of manners, the animal in fact undergoing a metamorphosis without actually changing its form. The smell glands which characterise almost every species of mammal belonging to this sub-primate group, become especially active during the mating season, and their emanations tend to attract members of the same species. Similarly, some animals use their voices only during the mating season, while almost all males use them much more while in rut than at other times, the call of one animal attracting another. Both smell glands and the voice may therefore be regarded as mechanisms for bringing the sexes together in this group of mammals. It is important to recognise, however, that they function equally well in those species in which the sexes maintain an anœstrous association. The beaver, for instance, although living always in the society of its fellows, nevertheless possesses a remarkably well-developed smell gland. Their presence in these social animals suggests strongly that proximity of the sexes is not the primary biological significance of the anœstrous association.

The main physiological change in the rutting male is the increase in size of the testes and their transition from an inactive to an active state. During rut the impulse to mate appears to be fairly evenly sustained—except towards the end of the season, as the male gradually becomes spent. Depending on

his vigour, he attempts to mate with as many females as he can, and in order to do this it is necessary to keep as many females as possible to himself. This is effected usually by the formation of harems, each male zealously guarding his " wives " from the attention of others. But the direct stimulus to mate comes from the female, even though the male is now ready to mate at any time. Females become particularly attractive only when they are on heat, and it is only at such periods that they will mate. Rams, for instance, wander in and out of a flock of ewes searching for those on heat, remaining with these until they pass out of this state. In certain mammals heat lasts for only a few hours, in others as long as a week. All this reflects itself in behaviour, and it is accordingly doubtful whether those instances in which males are never seen with more than one female at a time represent true monogamy. Pregnant females are no longer a stimulus to the male, nor will they mate except under very artificial conditions. The moose is frequently quoted as an example of monogamy, as it is seldom seen with more than one female; but it is known that he changes his cow weekly. From physiological analogy, this would suggest that the female remains on heat for about a week. Whether this can be called monogamy is a matter of opinion. Males will continue to mate until they are completely exhausted. There are, as far as one can see, no innate tendencies towards monogamy or polygyny in the male mammal. The number of wives he possesses depends upon his vigour and dominance.

The main determining factor for mating, perhaps for all mammals except the Primate, is the female's willingness, and this depends on specific physiological changes within her. Mating occurs only while she is on heat (œstrus). This happens only once during the mating season in monœstrous animals, such as the dog, but in polyœstrous animals, such as the rat and mouse, œstrus, in the absence of pregnancy, will recur at regular intervals throughout the season, after which the reproductive organs become quiescent and a new anœstrus is commenced. The essential nature of the œstrous cycle is the same throughout this group of mammals, though the duration of each cycle or of its constituent parts varies from species to species. In the event of pregnancy resulting from mating during œstrus, changes occur which are the same in all mammals.

Each œstrous cycle consists of a " follicular " and a " luteal "

phase. The follicular phase is associated with the development of ova in the ovaries, the luteal phase with the changes which occur in the ovaries after the ova have been shed. Ova develop in follicles, which are filled with a fluid containing the hormone "œstrin." This hormone produces procestrous and œstrous changes in the reproductive tract. The procestrous changes consist mainly in growth of the lining cells of the generative organs, true œstrus following this growth phase. During œstrus the mature ova are discharged (ovulation), the cells produced in the procestrous growth phase degenerate, and a change occurs in the female demeanour. She is now on "heat," and it is only now that she is anxious to mate. She also becomes, as all who are in any way familiar with animals know, the immediate goal of male desire. In most species this new masculine regard is associated with an alteration in the female's olfactory quality. All females continue to desire to mate, and are a stimulus to the males until the commencement of the luteal phase. Œstrin activity ceases at the end of the follicular phase.

The luteal phase consists of changes preparing the uterus for the embryo, and in the event of successful mating, in further changes promoting its development. These changes are the result of hormonic stimuli from the corpora lutea, glands of internal secretion which develop in the cavities left by the discharged ova. This phase is important from the point of view of behaviour, as it stimulates maternal changes and maternal responses. Moreover, while it lasts, it inhibits the recurrence of œstrus and therefore of further mating. In the event of pregnancy the phase obtains full expression, but in its absence it is usually curtailed and is then known as pseudo-pregnancy. The degree of pseudo-pregnancy varies from animal to animal. In the unmated rat it passes unnoticed, œstrus recurring in five days; whereas in the marsupial its duration is usually the same as that of true pregnancy, and sufficient change is occasioned in the female organism to influence behaviour considerably. The marsupial cat, for instance, proceeds to clean her pouch in preparation for non-existent young.

Such, briefly, are the main physiological changes which occasion the social and sexual behaviour of perhaps all mammals except the Primates. Relations of the sexes are limited to mating seasons. During these seasons masculine interest in the female

is demarcated sharply by the occurrence of specific œstrous changes in her, which, in the majority of species, are revealed through the olfactory apparatus. Similarly, the female's interest in the male is confined to her periods of œstrus.

For the Primate there are no such limitations of sexual interest or sexual activity. Anœstrus, in the sense of absolute quiescence of the reproductive organs, does not occur. Many species are known to breed at any time, while the females of other species, of whom it is said that reproduction is limited to certain months of the year, nevertheless manifest continuous cyclical physiological changes in the generative tract. Moreover, breeding seasons, if they do exist, are characterised by a lack of fixity, for in captivity they are immediately lost. Overt sexual behaviour, for many reasons, is also unrestricted. No monkey, from the very commencement of a captive life, has failed to exhibit continuous sexual activity in some form or other, unless it be one of those monkeys who never take to a life of confinement, and who fail completely to manifest any evidences of reproductive activity.

This continuous sexual activity of the Primate is probably the main reason underlying the permanent association of the two sexes, for, unlike most other mammals, the sexes never separate.

It is almost unnecessary to look for further explanations for their permanent union ; but another obvious social and sexual bond is the operation of " fleaing " or " picking," which all infrahuman Primates exhibit. " Fleaing " is a misnomer. Monkeys when picking through each other's fur are in search of loose scaly fragments of skin and particles of skin secretion, not vermin. This delicate operation, made possible by exceedingly well-co-ordinated movements of the fingers, associated with exact accommodation and convergence of the eyes, is also a clear indication of the Primate's superior sensori-motor apparatus when compared with that of any other mammal. The performance is of distinct sexual significance. Apart from the obvious satisfaction obtained by the picked one through the gentle stimulation of numerous cutaneous end-organs, opportunity is provided for examination of all parts of the body, with the not surprising result that " picking " frequently results in more direct sexual activity. There can be no doubt that the monkey's superior visual and motor powers assist in reducing physiological control of sexual behaviour.

The mechanisms subserving meeting of the sexes of the lower mammal are not found in Primates. A seasonal variation in the voice, for instance, does not occur in any monkey or ape; neither do they possess smell glands, the main mechanism subserving meeting of the sexes in the lower mammal. This distinction between Primates and other mammals has important theoretical bearing. The lack of these factors in the Primate may be looked upon in a Lamarckian manner as an outcome of the permanent sexual union. On the other hand, one may see in their absence added reason for such union, acting through the forces of natural selection; for if the sexes separated, the chances of meeting and mating would become precarious. The non-development of smell glands is correlated with the relative unimportance of the olfactory sense in the Primate Family. This again is related to the arboreal ancestry of the group, for the uses of this avenue of perception are limited in an arboreal existence, and correlated with this one finds throughout the Primates a marked diminution in the olfactory apparatus. Moreover, such an environment leads to a greater development of the visual, tactile, acoustic, kinæsthetic, and motor functions. As Elliot Smith first pointed out, it is in the greater development of those portions of the brain in which these functions are represented that one may read the progressive evolution of the Primates, an evolution culminating in man.

This transition from olfactory to visual dominance is reflected in differences which exist between the œstrous cycle of the lower mammal and the approximately four-weekly menstrual cycle exhibited by the females of all Primate species thus far observed.

The menstrual cycle, like the œstrous cycle, consists of follicular and luteal phases. But in the Primate these are not so well separated as in the lower mammal. Ovulation occurs about the middle of the menstrual cycle, but is unaccompanied by a breakdown of cells, such as occurs at this stage in the lower mammal. A luteal phase then follows, terminating, in the absence of pregnancy, in breakdown or menstruation some two weeks later. The fact that the female Primate engages in sexual activities throughout the cycle, together with the absence of œstrous degeneration, have made it difficult to determine the limits of activity of the hormone œstrin, with the result that current interpretations of the Primate cycle are obscure and unsatisfactory. A set of physiological facts

recently discovered, however, coupled with accurate observation of the changes which characterise the follicular phase in Primates generally, would appear to provide a ready and satisfactory explanation. It has recently been shown that cycles may occur in the Rhesus macaque, the common Indian monkey, without the occurrence of ovulation, and it is believed that this may happen in all Primates. Though no luteal phase occurs in such cases, breakdown still ensues at its expected time at the end of an approximately four-weekly period. Now the only changes which could have occurred during such a cycle are those connected with the follicular phase. This implies that there is an undercurrent of " œstrin " activity throughout the cycle. The breakdown which characterises the withdrawal of the œstrin stimulus at ovulation in lower mammals occurs after ovulation in the Primate, coinciding with the breakdown which, in the absence of pregnancy, terminates the luteal phase. Thus the hormone, which in its sharply demarcated activity completely limits sexual response in most female mammals, apparently remains functional throughout the entire menstrual cycle of the Primate. Here is probably the main reason for the Primate's continuous sexual activity.

The effect of the hormone œstrin is to prevent sterile mating. In the lower mammal it acts in such a way that mating will occur only when there are mature ova ready to be fertilized. Though it certainly does not ensure this in the infrahuman Primate, it nevertheless occasions changes which, judging from numerous observations, effect a similar purpose; these changes are, mainly, swelling and coloration of the perineal area of the female. The degree of this swelling and coloration and its exact distribution varies from species to species, being most marked in the baboon. These phenomena occur in all genera of Old World monkeys and apes, but certain species appear to be excepted. It is significant, however, that close observation is slowly adding to the list of monkeys which show them, and many which previously were believed to present no changes are now known to provide external indications of the hormone's activity.

The responsibility of œstrin for these changes has been proved in about three monkey species only, but, as the changes have practically the same time relations in all species, it is a fairly safe assumption that they are all caused by the same agency.

Commencing at the beginning of the cycle, swelling and

coloration reach their maximum in about a week, remaining for another ten days or so at their height, when they rapidly disappear. The wane occurs approximately one or two days after ovulation. Mating occurs most frequently when these changes are at their height. It is then that the female is most desirous and also most attractive to the male, and it is then that fertilisation is most likely to occur. This phase corresponds to the œstrus of the lower mammal. The males of other mammals are "informed" of the female condition by means of olfactory stimuli mainly, though vision may act secondarily in some species. In the Primate, on the other hand, visual and tactile senses have become dominant, and it is through these paths of perception that the male becomes aware of the female condition, while olfaction functions purely secondarily. What occurs in those Primate species that apparently do not undergo external change is doubtful. It is possible that in such infrahuman Primates the hormone occasions changes appreciable to the members of that species, though not obvious to man, for there is little doubt that our perception differs vastly from theirs. In man, however, the hormone œstrin, so far as one can tell, is not a determinant of behaviour.

It has been necessary to enter into these physiological facts because they are the principal mechanisms underlying the social and sexual behaviour of infrahuman Primates. In the absence of anœstrus and in the continuous and gradual cyclical variation in the female's attractiveness, as opposed to the sharp transition of the lower mammal, are seen ample reasons for the permanent sexual association which characterises the social life of all Primate species.

Systematists recognise some three hundred species of Old World monkeys and apes, included in about twenty genera, and about one hundred and fifty New World monkeys in twelve different genera. The natural habits of but a few, however, are adequately described, and for the rest one has to rely on the casual remarks of collectors and field workers regarding the numbers seen in troops. Moreover, reliable information about some very important species, for instance the chimpanzee and orang, is exceedingly scarce. Nevertheless, there is sufficient evidence, one feels, to make the generalisation that the tendency of infrahuman male Primates is towards polygyny. The few accounts indicating that monogamy occurs in certain species can in almost all cases be countered with

conflicting observations. Every adult male attempts to secure for himself as many females as possible. There is no selection. The most dominant males secure for themselves the largest number of wives, and maintain ownership until they are deposed. For the first time in the mammalian order the female plays a completely passive part, and here are the only certain permanent sexual associations, apart from human, shown by mammals.

Monogamy and polygamy may exist side by side in the same species, depending as they do on the distribution of those qualities which go to make masculine dominance. There is a greater amount of individual variation, for instance in size, in the males than in the females of infrahuman Primates, and while no one as yet has investigated the differences in variability between one species and another, it may be that those species in which monogamy is the more frequent arrangement are those which exhibit a lesser degree of masculine variability. That masculine variability within the species is an important consideration is shown by the following instances. In the colony of Hamadryas baboons at present owned by the Zoological Society of London, eight of thirty-nine adult males possess the only nine females, and it might be said that monogamy is the prevailing rule. On the other hand, in December last year in a similar baboon colony in Münich, consisting of twenty-five adults of each sex and about one hundred subadults, five males possessed all the females, one owning seven. This colony was reduced in size, and in April of this year consisted of ten adult females, eight adult males, and forty male subadults. Four of the adult males owned all the females, one owning four, another three, a third two, and the fourth one. Such irregularity in the distribution of the females can depend only on variability in those qualities which go to make masculine dominance. What these qualities are is doubtful. Size is certainly not the only factor involved, for a larger male baboon is often dominated by a smaller.

Another factor which one feels ought to be taken into account in order to understand the distribution of wives is sexual dimorphism. The males of all species of Primate are larger than the females, but the actual amount of difference varies from species to species. In the baboon and gorilla, for instance, it is very marked, while in the chimpanzee and gibbon it is far less so. This seems to impress itself in social relationships, for while there are some records of gibbon and chimpanzee monogamy,

opinions are almost unanimous about the polygyny of the baboon and gorilla. It would seem that the female gibbons and chimpanzees are more capable of asserting themselves than are their relatively weaker sisters.

The harem is the social unit of monkeys and apes, and one may recognise two main types of society arising from it. The first, exemplified by the societies of the majority of tree monkeys, consists of the single harem living alone. The second is the society formed by the union of several harems. The best examples of this type are the societies of baboons, who are very seldom reported in troops of less than twenty, and have been seen in hordes consisting of as many as three hundred individuals. An intermediate type also occurs, several harems uniting to form temporary associations. Abundance of food supply in a particular area may be one of the causes underlying such associations, although it is said by field workers that each group of apes and monkeys has its own territory from which it does not stray. The present state of observational knowledge does not justify theorising about specific gregarious instincts, and there is little in the accounts of field workers by which to arrive at a true understanding of the real nature of these temporary associations.

The gorilla, for instance, which spends the greater part of the day patrolling the forests of Central Africa in single harems, has been encountered on a few occasions in larger groups, consisting of several families ; these associations have been seen to break up into their constituent parts. The chimpanzee is known to associate in bands of about twenty, which are considered by certain naturalists to represent permanent societies, but, curiously enough, far less is known of the mating arrangements of this more accessible African anthropoid than is known of the gorilla. The evidence, however, clearly suggests that the more dominant males possess the larger number of females. One is left wondering about the natural habits of the orangs of Borneo and Sumatra. They have been alternately described as leading solitary lives in sexual segregation, of living together in virtuous monogamy, and of having the same habits as the gorilla. Many of the males shot by collectors, however, bear evidence of fighting, and accordingly there can be little doubt that they too possess a harem system sustained by masculine dominance and jealousy. The gibbons are confined mainly to the forests of the Malay Peninsula. All, with the exceptions

of the Siamang and Hoolock, live in small family parties. The latter two species, however, are usually encountered in large bands, which, because of the timidity and agility of these animals, have never provided opportunity for close study. The strictly arboreal guerezas of Africa are known to associate in small parties only. The langurs are confined to India, Burma, the Malay Peninsula, and certain of the larger neighbouring islands. With the exception of the Entellus, they too are strictly arboreal, and in the more inaccessible tracts, rarely penetrated by man, live in single harems of which we possess fairly adequate descriptions. The Entellus langur, the sacred and until recently generally protected Hanúmán monkey of India, has probably a wider distribution than any other langur. Away from man it lives in a manner similar to that of its fellow-species. Where it has come under human protection, however, it lives close to villages, in larger and smaller bands, consisting of several families. The African tree monkeys, the guenons or cercopitheques, which constitute the largest Primate genus, are as a rule found only in single harems. A few species, however, for instance the Vervet monkey of South Africa, are encountered in bands containing as many as one hundred individuals, said to be made up of several harems. The strictly arboreal African mangabeys are found only in small parties. The habits of the macaques, a genus whose species are mostly arboreal, are similar to those of the langurs. Their geographical distribution, too, is much the same. On the whole, the species of this genus, both arboreal and terrestrial, live in single harems. The Gibraltar ape, for instance, the only free living infrahuman Primate in Europe, lives in separate polygynous families. The common Rhesus macaque, however, formerly venerated together with the Entellus, lives in large colonies close to human habitations. With almost no exceptions, the baboons, confined to Africa, live in rocky cliffs in bands containing more than one harem. Most commonly these bands contain from fifty to one hundred individuals, although larger associations are often encountered. Groups of less than fifty are rare. Information as to the habits of New World monkeys is strikingly inadequate. On the whole, their manner of life appears similar to that of their Old World cousins. Very few species are encountered in large bands, and as a rule they live in single harems.

It is very significant that, with the exception of the Hoolock

and Siamang, the species living in the heart of the forest away from the normal range of human beings are those which, according to the accounts of naturalists, live in single harems. Those living away from the forest zone, coming into close contact with man and pillaging his farms, are those which live in bands of several harems. Once the protection of the forest is discarded, new dangers, chief amongst which is Man, threaten. It would almost seem as though the larger association were an adaptation to meet them. It is almost impossible to assess the influence Man has had on the more recent evolution of apes and monkeys. The felling of forests exterminated Kirk's guereza in the island of Zanzibar; the efforts of hunters have converted a formerly peaceful animal like the Cameroon gorilla into an animal that charges Man on sight; the Pig-tailed macaque has become a semi-domesticated animal living on the outskirts of Singapore; few indeed of the better-known species of Primate having remained unaffected.

The sex ratio is approximately the same throughout Mammalia, the sexes being about equal in number. Polygyny, therefore, results in a certain number of males remaining unmated. Naturalists' accounts of all Primate species stress the occurrence of these males, one of two reasons usually being put forward to account for their presence. One rather novel view is that lone males no longer desire the company of females. The other, and correct, view is that these males are excluded from the society of females by the overlords of the harems. The " bachelors " of species which live in separate harems are generally excluded from all contact with the harems. Such " bachelors " either roam alone, for instance the gorillas, or, like the Entellus langur, form male bands. Occasionally, where the dominance of the harem's overlord is assured, they may form part of the harem, though they have no relations with the females. " Bachelors " are included in the large associations of baboons, forming a rather curious class within the society. The dominance of " married " males is the cause of all infrahuman Primate associations being " closed societies." No stranger is admitted. Attempts to join pre-existing bands result in contests to determine dominance. If the overlord is not deposed, the stranger, if still alive, may be suffered to remain. Numerous attempts to introduce fresh Barbary apes to the Rock of Gibraltar, for instance, have ended in their deaths at the hands of the older population. This, too, is the

usual experience in Zoological Gardens, all new-comers being " shown their places." Domination extends to all things, not only the sexual sphere. The weaker members of a cage are often prevented from eating by their stronger fellows, so that in the housing of monkeys a great deal of attention has to be paid to the choice of cage companions.

The more or less recent establishment of colonies of Hamadryas baboons in many European Zoological Gardens has provided excellent opportunity for careful study of the social relationships of these monkeys under conditions approaching their natural environment as closely as is possible in a state of captivity. These relations are in no way subjected to human interference. Observations made in London and Münich have shown that the internal arrangements of such colonies are always the same. Their more prominent features, without entering into detail, are as follows.

Each colony consists of harems, bachelors, and children. The individual harems never come into close contact with each other, and certain of them are more inclined to keep away from the main body than others. The " married " males in all cases dominate the " bachelors " who will invariably move away from any favourable spot in which they may be, on the approach of a harem.

Females are completely dominated by their males, following them wherever they go. The bond between male and female is, however, closest when the latter is " in œstrus." At such time the female hardly ever moves from the male's side, whereas in the quiescent phase she may sit several feet away from him. When more than one female is owned by a male, priority in the harem is taken by the female " in œstrus."

In some instances a male will follow readily where his female leads; in others, if a female wishes to move, or to remain where she is, against the male's desire, she attempts to get her way through sexual approach. Both sexes of all ages appear to present themselves sexually to those of their fellows whom they fear; this appears to be a means of diverting assaults.

Daily observations of the London colony since the beginning of this year have failed to show one instance of a female having had sexual relations with any adult male but her own. In fact, any sexual advance by a " bachelor " leads to an immediate fight. Since the beginning of the year, however, no " married " male in the London colony has been deposed. On the other

hand, it has been noticed on a few occasions, both in London and Münich, that the male overlord pays no attention when his females are unfaithful with immature males.

Occasionally a " bachelor " becomes attached to a harem. He moves with the family, and engages in reciprocal " picking " with its members. Sometimes the head of the harem turns on these " bachelors," and ejects them. Little males also occasionally attach themselves to harems.

" Bachelors " form a rather disjointed group, varying greatly in temperament. Fights are common between them, but their causes are not readily discernible. " Married " males seldom pay attention to the bickerings of " bachelors," turning on them as a rule only when they exhibit heterosexual interest. Exhibitions of dominance in other spheres are also causes for dispute. Deliberate attempts to destroy the existing order by seducing a female from her male are rare. In the London Gardens, rearrangement of females usually follows the death of a married male. Such an event is followed by severe fights, in which the female is not infrequently killed.

All baboons manifest homosexual tendencies. Amongst males this type of response is most frequent amongst the " bachelors," though married males occasionally have homosexual relations, generally with " bachelors," and very rarely with each other. There is less homosexuality amongst females, and what there is is restricted to the members of the same harem. Such behaviour, too, is stimulated mostly at particular phases of the menstrual cycle.

Children born into these artificial colonies rarely survive. For about the first six months of their lives, once they have learned to walk, they are seldom out of the mother's reach. Apart from nursing, the mother never gives her child food, and the father pays almost no attention to it. After the first six months of life, the greater part of the day is spent in the company of other members of the colony, mainly the " bachelors." Only one female, apart from the mother, has ever been seen to pay any attention to the babe now living in the London colony. Young Hamadryas baboons are very playful, and soon learn all the behaviour of their elders. Sexual activities are manifested almost as soon as they leave the immediate family circle. As the young males grow up, they join the society of " bachelors," while the females become attached to harems before they are sexually mature.

These briefly are some of the facts about infrahuman primate society. It was from a similar social level, so far as one can tell, that, in the Oligocene or Miocene, an anthropoid set out on its journey towards manhood. Nothing is known about this journey. At the one extreme there is the anthropoid in its harem, a frugivorous animal who reveals just the beginnings of a reasoning process. At the other is Man, whose every activity is culturally conditioned. The only possible social sphere of comparison between the two is the family, yet nowhere in the human world does one see anything approaching the harem of the infrahuman Primate. One fact is, however, clear. There is no need to search for cultural factors to account for Man's permanent sexual association, for this feature is one shared by all Primates alike. This consideration should not be overlooked in the still disputed problem of the genesis of the human family. For instance, the hypothesis of certain anthropologists, that the monogamous human relationship evolved from a promiscuous level, implies that once the anthropoid stage had been passed, promiscuity for a time replaced the dominant harem. On the other hand, the view that monogamy is as old as mankind itself leaves unexplained the transition from a dominant harem to a cultural monogamy. Further knowledge will be necessary, however, about the familial life and food conditions of primitive man before adducing fresh hypotheses to explain the origin of the human family from an infrahuman level.

L'Homme Machine:

A Brief Account of Pavlov's Conditioned Reflexes

E. B. STRAUSS

PHILOSOPHY will always exist, for it satisfies a very real need of the mind of man. Its function is to synthesise the discoveries in Natural Science and extract from the synthesis universal principles. It is an interesting fact that modern systems of philosophy are for the most part the work of natural scientists rather than "professional philosophers" or pure metaphysicians. It is not my present intention to indulge in speculations as to whether the results have been satisfactory, nor even to express an opinion on the philosophy of Pavlov. It is, however, certain that the metaphysical or psychological conclusions derived from experimental scientific work either by the original worker or his commentators may prove to be of infinitely less value than the work from which they sprang. Pavlov's work is already being widely discussed in this country by people who take an interest in the psychological aspects of the biological sciences, but who are for the most part lacking in physiological knowledge or training. The result of this widespread interest will be felt in the realms of philosophy, psychology, animal biology, pedagogy, applied neurology, and even religion. This irradiation of cultural influence may be as considerable as that which followed the publication of *The Origin of Species*. It would be interesting to know how many people read that book as compared with those who discussed Darwinism with only the faintest knowledge of the chain of observation and argumentation which led Darwin *tentatively* to formulate his brilliant hypotheses. It is the object of this article to stimulate in the reader an interest in the work of Pavlov which has been translated into English. In "*Conditioned Reflexes*" we are given, in an admirable translation by Dr. G. V. Anrep, an account of twenty-five years of experimental work, undertaken in Leningrad by Prof. Pavlov and his assistants, on the higher nervous activities of animals.

In the sixteenth century René Descartes conceived the idea of reflex activities and stated that animals are *automata*; he implied that man, in so far as he partakes of animality, was also the *locus* for the play of various automatic and mechanical

processes. But the very foundation of Descartes' philosophic system was a belief in the existence of God. A century later, Julien Offray de Lamettrie, the first thorough-going atheist and materialist to give expression to his views in Christian Europe, defended the thesis, in his work *L'Homme Machine*, that all psychical phenomena can be accounted for in terms of organic changes in the central nervous system. Man is a mere machine; God and the soul are otiose. It will be held that Pavlov is a new Lamettrie, supporting the same thesis on experimental instead of inductive grounds.

Pavlov's method of approach is essentially different from that of Watson and the other students of animal behaviour, in that he investigates his problems at the physiological level without any recourse to the methods of psychology. The study of reflex activities has proceeded historically in a definite " hierarchical " order. Starting with Descartes' conception of the reflex, various workers in the eighteenth, nineteenth and the present century have studied the mechanisms at the various neural levels, culminating in Pavlov's experimental investigations into those reflexes which depend upon the integrity of the cerebral cortex for their acquisition and retention. Sir Charles Sherrington, working on spinal reflexes, and the late Professor Magnus, who studied reflexes dependent on the lower cerebral centres, successfully demonstrated that all the more elementary motor activities of animals are reflex in nature. In fact, with a physiological bias, it is now possible to express all animal behaviour of the type usually called instinctive in terms of elaborate chain reflexes. In other words, instinctive behaviour is strictly *determined* and mechanical. How much further can this determination be carried? how far are the activities which are usually regarded as mental merely determined phenomena of stimulus and response? Are we, together with the rest of the animal species, merely automata? Must Descartes' sublime dictum *cogito, ergo sum* perish before the new onslaughts of *L'Homme Machine*?

It is clearly impossible, in a short article of this kind, to give even the most sketchy account of Pavlov's experiments; but some of the fundamental principles resulting from Pavlov's studies may be set out.

What is a reflex? A reflex is the *effective*[1] response of a living organism to an external or internal stimulus, independent of

[1] Effective—i.e. as opposed to *affective*.

consciousness and volition. A reflex demands, therefore, a stimulus, a receptor organ to receive the stimulus, a path in the central nervous system to convey the impulse thus generated to a more centrally situated station, whence it is transmitted by another pathway to an effector organ which effects the physiological adjustment or response to the original stimulus. Certain reflexes are common to the species, that is to say, that they are part and parcel of the inherited physiological equipment of every normally developed member of the species. The most elementary of this kind of reflex are concerned with such primitive activities as protection, or withdrawal from injury, secretion, excretion, alimentation and reproduction. They can occur after the removal or destruction of the higher cerebral centres. Thus, a dog whose brain has been removed will respond to an irritative stimulus applied to its flank in the same way as a normal dog, i.e. it will scratch vigorously, as long as the stimulus is continued.

There is another great group of reflexes, which are not inborn and which must be acquired afresh by each individual member of the species. They depend, as we have already stated, on the integrity of the cerebral cortex which contains the highest brain centres, i.e. those of latest acquisition, evolutionarily speaking. These reflexes have been termed *conditioned reflexes* by Pavlov, who was the first to investigate their properties and modes of action. They have several points of resemblance to the inborn reflexes; they share the same effector organs and employ the same peripheral end-organs of reception. But as we shall see, they also show great differences.

Let us consider a simple unconditioned (i.e. inborn) reflex in a dog. Food is placed in a dog's mouth—the unconditioned stimulus; saliva is produced by the salivary glands—the unconditioned reflex response; the exact quantity secreted can be measured by an appropriate technique. This reflex would occur if the animal were deprived of all its "higher" faculties. But there is also a reflex salivation in response to such stimuli as the sight or smell of the food, or the sound or sight of the person who usually brings it; such a production of saliva used to be called the "psychical" flow, and clearly depends on associational memory. It is a reflex of a higher order than the direct inborn response to the contact of food with the mucous membrane of the mouth and tongue.

Suppose now that the presentation of food be associated

on several consecutive occasions with an hitherto completely indifferent stimulus, such as the ringing of a bell; it is found that this auditory stimulus unaccompanied by the presentation of food brings about the secretion of a copious quantity of saliva. This is clearly a reflex of a new order. It is called a conditioned reflex, because the ringing of the bell has been previously "conditioned" by the presentation of food. If the ringing of the bell occurs several times without the presentation of food, the quantity of saliva gradually diminishes, until the conditioned stimulus fails to produce any reflex response. The reflex is now said to have undergone *inhibition by extinction*. That the reflex has been "inhibited" and not abolished is shown by the fact that it can be gradually restored by the recombination of the conditioned and the unconditioned stimuli on only one or two successive occasions. The association of the two stimuli has left its "trace" in the cerebral cortex.

Conditioned reflexes may be inhibited in a variety of ways. If in the course of an experiment a sudden extraneous stimulus, such as the opening of a door, the arrival of a stranger or a blast of cold air intervenes, the conditioned reflex flow of saliva will cease. This form of inhibition is known as *external inhibition*.

The mechanisms of *internal inhibition* are more various and complex. Suppose that the conditioned stimulus be the sounding of a certain musical note, the dog will develop conditioned responses to tones which are fractions of intervals above and below the true note. If the sounding of these "untrue" notes be unaccompanied on several successive occasions by the presentation of food, whereas the combination of food and the true note is kept constant, in other words, if the "untrue" reflexes be submitted to experimental extinction, the dog will give a full conditioned response to the "true" and fail to respond to the "untrue" stimuli. The "untrue" reflexes are now said to have undergone *inhibition by differentiation*.

Now let us suppose that our dog has acquired a well-established conditioned reflex to the sounding of a bell, and that this stimulus be now accompanied several times by an hitherto indifferent stimulus, such as the ticking of a metronome, without the presentation of food, it will be found that on a future occasion the sound of the metronome has acquired the property of by itself inhibiting not only the conditioned reflex already

mentioned, but that it has also acquired an inhibitory influence over other conditioned reflexes possessed by the dog. This form of internal inhibition is known as *conditioned inhibition.*

When external inhibition is combined with internal inhibition, an interesting effect results, namely the inhibition of inhibition or *disinhibition.* In illustration of this, let us suppose that the dog has acquired a well-established conditioned reflex to the ringing of a bell, and that the ticking of a metronome has been made a conditioned inhibitor in connection with this reflex, just as in the case mentioned above. In the course of an experiment, the exhibition of a flashlight is added to the conditioned stimulus and the conditioned inhibitor (the bell plus metronome complex), reflex salivation now recurs. The internal inhibition has been lifted by the external inhibition, revealing the original conditioned reflex.

If the stimulus which it is desired to condition precede the unconditioned stimulus, no conditioned reflex develops, unless there is a certain amount (no matter of how short duration) of overlapping of the two stimuli. Thus, if the ringing of the bell precede the presentation of food without any overlapping of the stimuli whatsoever, the dog does not acquire a conditioned reflex to the sound of the bell. But there can be a delay as long as three minutes between the stimuli if their order of application be reversed, with the successful acquisition of a conditioned reflex flow after a latent interval corresponding to the period of delay. Thus, suppose that the bell be rung on several successive occasions three minutes after the presentation of food, the ringing of the bell by itself produces a flow of saliva after a delay of three minutes (the latent interval). There is abundant experimental evidence to show that this latent interval is the result of internal inhibition, a form of inhibition which might be termed *inhibition by retardation.* This type of conditioned reflex is known as a *trace reflex.* These reflexes are the most easily lost and subjected to inhibition.

If a dog has acquired conditioned salivation to several separate conditioned stimuli, their simultaneous application produces a greater quantity of saliva than each is capable of producing individually. The stimuli reinforce each other; there is *summation of effect.* In the same way, different internal inhibitors can undergo summation; in fact they obey precisely the same laws as excitatory stimuli, only with a change of "sign." Hence the term *negative conditioned reflexes* for the

reflexes resulting from such inhibitory combinations is accurate and convenient.

The irradiation of a nervous impulse so as to invade other nervous centres is a familiar neurological phenomenon. Let us see how irradiation affects the mechanisms of conditioned reflexes. If the stimulation of a certain spot on a dog's skin be conditioned to cause reflex salivation, it is found after a time that the stimulation of other spots in the neighbourhood causes reflex salivation, but that the farther away from the area of original stimulation these spots happen to be, the flow of saliva will be correspondingly less. It is found that the irradiation is most extensive when trace reflexes are concerned ; in such experiments the area which on stimulation gives rise to a strong response is less circumscribed.

Another phenomenon dependent on the irradiation of excitation is illustrated by the following experiment. We will suppose that our dog is a fierce animal, that is to say, possessed of a well-developed " aggression-reflex," to employ the kind of terminology which may become current. He is salivating reflexly, say in response to the sound of a bell, when a stranger unexpectedly enters the room. The animal growls, bristles and shows signs of fight. The flow of saliva increases considerably, owing to the excitation overflowing its proper cortical limits and invading the centres concerned with the conditioned reflex. In a more phlegmatic animal, the unexpected foreign stimulus would have caused external inhibition of the reflex.

Inhibition can irradiate in the same way as excitation, leaving a *trace* of its passage in its wake. This is one of the many cogent reasons for regarding inhibition as an active process opposite in " sign " to excitation, and not merely as an absence of excitation. To illustrate this, we will consider the following experiment. Five equidistant spots are plotted on the skin of a dog's leg, which we will call spots I to V from above downwards. Tactile stimulation of spots I to IV is conditioned to produce reflex salivation, whereas spot V is stimulated on several successive occasions without the presentation of food, so that its stimulation acquires an inhibitory character. We thus have four " food-spots " and one " no-food-spot." Spot V is stimulated, no salivation occurs ; after a brief interval spot IV is stimulated, stimulation of which previously gave rise to a copious flow of saliva ; now no salivation occurs, showing that the inhibitory impulse has spread to the cortical area corre-

sponding to spot IV. Spot III is now stimulated, and the reflex flow is shown to have undergone a considerable decrement. With spot II the decrement is less marked ; and the stimulation of spot I is followed by as copious a reflex flow as previously, showing that the wave of inhibition has touched its limits. Both the speed and strength of this wave can be measured. If the interval separating the stimulation of spot V from that of spot IV exceed the time requisite for complete inhibition, it is found that spot IV is re-acquiring its excitatory character. This return to " normal " is termed *concentration* ; the time taken by the spread of " concentration " is also ascertainable. Concerning the phenomena of irradiation and concentration Pavlov has formulated the following hypothesis. Any exciting or inhibiting process started at some point in the cerebral hemispheres, by virtue of definite peripheral stimuli, is subject to certain types of movement along the surface of the hemispheres, the speed of which can be measured not only by seconds but also by minutes. These movements are in two directions: (*a*) spreading (irradiation), (*b*) return to original point (concentration). The reason why it is emphasised that the spread of these impulses is measurable in minutes as well as in seconds is that this fact indicates that the impulses leave their trace or *after-effect* on the nerve cells or junctions through which they make their passage.

As the result of his experiments, Pavlov has come to the conclusion that the chief, if not the only, function of the cerebral cortex is the analysis of stimuli. The innumerable analytical centres postulated by this view are to be regarded as functional rather than as anatomical units. Apart from the primal " biological " centres, these analytical centres are not necessarily permanent. They are comparable to the physiological bases of the *engrams* postulated by Semon in his system of " Mnemic Psychology." The cortex is ceaselessly receiving showers of new stimuli from the periphery ; the analytical centres analyse these stimuli and synthesise therefrom appropriate reflexes. We have already stated that behaviour at the instinctive level can be expressed in terms of chains of in-born reflexes ; the present implication is that behaviour at a higher level is interpretable in terms of chains of conditioned reflexes, and the mechanisms subserving them, namely excitation, irradiation, inhibition, disinhibition or release, and concentration.

Concerning the manner in which a peripheral stimulus will act, Pavlov says: "There is one condition, the presence or absence of which will decide whether the impulse brought from outside into the cerebral hemispheres will call forth a process of excitation or inhibition for any length of time (in other words, will be positive or negative). If the stimulus coincides with any other stimulation in the hemispheres, or lower cerebral centres, it will remain positive. If it does not it will sooner or later begin to act negatively. Both these processes have the property of spreading to other points, and if in so doing a positive one coming from the one point crosses the path of a negative one coming from another point, a conflict will ensue, the result of which will be a reciprocal limitation to definite regions (physiologically, of course, not anatomically speaking). Thus there is an ever-present strife, the balancing of which gives us normal behaviour."

What about abnormal behaviour? The "psychopathology" of conditioned reflexes is still in its infancy. It is, however, interesting to record that Pavlov has been able to produce by experimental methods a condition in dogs which is strictly comparable to neurosis in man. The genesis of this "experimental neurasthenia" seems to be due to an overstraining of the animals' capacity for inhibition.

Sleep and hypnosis are also explained by Pavlov in terms of inhibition; both are inhibition of wide cortical spread. This interpretation of sleep was forced on Pavlov, as it was the only explanation of the somnolence which frequently occurred in his dogs during the course of experiments. We will consider the following experiments to illustrate this point. The normal response by a dog to an unexpected indifferent stimulus, such as a sudden sound, is for the animal to turn his peripheral receptors in the direction of the stimulus. Thus, if a sudden unexpected noise be made in the vicinity of a dog, he will immediately turn his head in the supposed direction of the sound and cock up his ears. This reflex has been called the *orientation* or *investigatory reflex*. If such a stimulus be repeated several times running at short intervals, the dog soon ceases to *orientate*; if the stimulation be kept going, the dog becomes drowsy and uninterested and soon falls into a deep sleep. The orientation reflex is first inhibited, and later the inhibition irradiates throughout the cerebral hemispheres, and sleep results. The soporific effect of unrelieved monotonous stimu-

lation has always been recognised, examples being the rocking of the cradle, the tedious lecturer, and so on; but here we have the phenomenon explained in terms of physiology.

It cannot be denied that in studying the properties of conditioned reflexes Pavlov has uncovered *mechanisms* of almost incalculable importance, which, in combination with the properties of the nervous impulse previously discovered by Sherrington and other earlier workers, throw a completely new light on animal behaviour. But have we now got " the whole story " ? Certain ultramechanistic students of behaviour, with a passion for simplification, have attempted to deny the existence of mental processes as such, and to sum up animal and human behaviour in terms of reflexes, *tropisms*, and similar physiological mechanisms. However, in the writer's opinion, we have not yet reached the stage when volition (and certain other concomitants of conation), perception, conception, and the like, can be *wholly* expressed in terms of pure physiology. It may be that, metaphysically speaking, physiology and psychology are different aspects of a greater whole, but our minds are so constituted that the one can never be satisfactorily expressed *in toto* in terms of the other. The study of conditioned reflexes certainly seems to provide a kind of *liaison* science between the two.

In conclusion, I will try to indicate how Pavlov's work *may* influence psychological thought. Pavlov has demonstrated that the mechanisms of excitation, inhibition, irradiation, concentration, reinforcement, and after-effect apply to all neural processes, and govern behaviour. Attempts will probably be made to make them apply to all neural processes occurring at the psychological level. The cortex is, as we have seen, a receptor organ; the stimuli with which we have dealt so far have been transmitted to the hemispheres from the peripheral receptors. But stimuli can arise within the cortex, and generate neural activity of reflex or other kinds.[1] In other words, psychical stimuli of the nature of emotions, desires, memories, and the like, can act in the same way as those which reach the brain directly from the outside. The brain, and by analogy its psychological correlate, the *mind*, are to

[1] This statement is only practically true. Emotion and the kind of psychical stimuli mentioned here depend on memory, and memory originally derives from peripheral stimuli. It is realised that retrospectively at the physiological level we cannot escape from the reflex chain.

be regarded as in a continual state of balance or imbalance between excitation and inhibition, which states are in turn influenced by the other neural mechanisms listed above. The neural energy involved may find expression in three ways: (1) in action alone (reflexly); (2) in action plus awareness (controlled action); (3) in thought alone (consciousness). Neural energy (the nature of which we are not here concerned with) must be regarded as *undifferentiated* and *undirected* until it has passed through various "centres" in the brain and spinal cord, where it is analysed and appropriately "canalised." This suggests a theory of consciousness which may be explained in the following terms: *Neural energy, in the course of differentiation in response to internal or external stimuli, may partly or entirely escape effection and remain at the level of reception, thus forming the physiological basis of what is called consciousness.* Elements of consciousness may themselves be subject to inhibition; partial inhibition produces neural processes at the level of the Freudian *preconscious*, and complete inhibition at the level of the Freudian *unconscious*.

It is possible that a new system of psychology and psychopathology may be erected on premises such as these, a system which will stand the strain of biological criticism, because its foundations are firmly built on the basis of experimental physiology, and which will satisfy the philosopher in that it embraces psychological concepts, whilst seeking by analogy to interpret them along with their physiological correlates.

Philosophy and Aldous Huxley

C. E. M. JOAD

MR. HUXLEY'S admirable article in the first number of THE REALIST, ostensibly concerned with Pascal, is in effect a disquisition on philosophy. Mr. Huxley avows the fact. " Pascal is really only an excuse and a convenience," he writes. " If I choose to write about him, it is because he raises, either by implication in his life, or explicitly in his writings, practically all the major problems of philosophy and conduct." " In the margin of " what he calls Pascal's " guide book," Mr. Huxley has " pencilled a few reflections. This essay," he continues, " is made up of them. Pascal is only incidentally its subject." And the disquisition upon philosophy turns out upon examination to be less a disquisition than an assault, an assault of which the object is to show that philosophy, as opposed to science and, presumably, to common sense, is and must of necessity be moonshine. The word is not Mr. Huxley's—he is indeed exquisitely polite to philosophy —but I want to convey briefly the upshot of his article, and he will forgive a philosopher for using bluntly the words that he has minced.

The assault, directed against philosophy as a whole, has for its special objective rationalistic philosophy, that is to say, metaphysical systems which claim to be able to discover the fundamental nature of the universe by sheer process of logical reasoning. And what Mr. Huxley has to say about them is something like this.

If you want to know what the universe is like, you must go and see ; in other words, you must follow the methods of science. Observe facts, correlate them, state your conclusions in the form of scientific laws, and your laws will apply. They will give you, that is to say, information about a world external to yourself ; they are, to drop into philosophical jargon, objectively valid.

Directly, however, you begin to speculate about the facts that science catalogues, directly you begin to follow out their implications, to reason at large about them, to make inferences, from facts about a special department of the universe to the universe as a whole, to infer, for example, what sort of universe it must be in order that the facts in question may occur in it,

directly, in a word, you assume the function of the philosopher, then your results are no longer objectively valid; they are merely rationalisations of your subjective needs and wishes. They cease to apply to any world outside yourself; they merely reflect yourself. What the philosopher does, in fact, is not to present us with a picture of the universe, but merely to project the creations of his own intellectual imagination upon its empty canvas. Having projected them, he discovers with a naïve surprise what he has projected, and announces a metaphysical system. The philosopher, in short, is one who fares through the uttermost confines of the universe to find himself.

Thus Descartes is criticised because being a rationalist, "he believed in the reality of his abstractions. Inventing fictions, he imagined that he was revealing the truth." Nor is it only the rationalists who are blamed; all philosophers who, racking their brains over the anomalies of the universe, evolve systems which purport to reconcile them, are censurable—censurable, that is to say, if they regard their fictions as having some pretensions to truth. And what philosopher does not? Certainly not Pascal. Selecting from the chaotic mass of concrete experience certain aspects which appeared to him to be interesting, the rest he magnificently ignores. The interesting aspects become Body, Mind, and Charity, three vicious abstractions "which have no existence outside the classifying intellect."

These are erected by Pascal into actual entities in whose reality he actually came to believe. The rest, all that does not fit in with the three Pascalian absolutes, is explained away.

It is the same complaint. The philosopher, whatever his school, constructs a rigid system and uses it as a Procrustean bed into which to fit the infinite variety of nature and experience; if they will not fit, so much the worse for nature and experience. But the system has no reality outside the philosopher's mind; it does not apply to anything, and the historic figures of Truth, Goodness, and Beauty, or (as in Pascal) Body, Mind, and Charity, with which it is adorned, are lay figures. From the same complaint is drawn the same moral. Observe phenomena, correlate them, construct formulæ which describe them and enable you to predict others like them, follow, in short, the methods of science, and you may rest assured that your results will be true at least of something. But, as soon as you sit back in your chair and reflect upon the nature of the universe in the light of the results, your conclusions are of interest only to the

psychologist. They tell us about you, not about reality. A philosophy is not an account of the universe; it is the symptom of a state of mind. Such, in brief, is Mr. Huxley's criticism. It is—it is obvious—fundamental; it is not directed against this philosophy or that, against Pascal because he believed in the objects of his revelations or Descartes in the products of his rationalising; it is a criticism of the aims and methods of philosophy in general, and of its claim to give an account of the universe in particular. It is this criticism which I propose in this article to try to meet.

Like Mr. Huxley I too have the habit of pencilling reflections in margins. Mr. Huxley's article on Pascal provoked a number. This essay is made up of them. Mr. Huxley is only incidentally its subject.

§ 1

The obvious retort assumes the form of a *tu quoque*. Must not Mr. Huxley himself, in denying the validity of systems, assert the very thing he denies? Are not the rationalising methods he indicts the methods upon which his own indictment is based? Probably they are. Mr. Huxley persuades himself that philosophical conclusions constructed by processes of reasoning on the basis of sense experience do not apply to anything. But how does he reach this conclusion? Apparently by process of reasoning from sense experience. He is using excellent philosophical arguments in defence of a philosophical position. The fact that the position consists in the assertion that all philosophical positions are a reflection of the self and not a transcript of reality, and that the arguments which he uses are devoted to showing that philosophical arguments are vicious rationalisations of instinctive wishes, does not in the least detract from the philosophical character of his achievement. It merely stultifies it. Following a well-known philosophical method—it is as old as the Greeks, and in direct line of descent from the Sophists—Mr. Huxley reaches the conclusion that philosophical methods are fallacious; the conclusions to which they lead do not give us truth about reality. Then he should not follow them. Nevertheless he does so continually, and not only to discomfit the rationalists, for he has tried, he tells us, to frame a way of life and to draw what he calls a map of reality. But how does he know that it is not merely a map of his own mind?

The point is an obvious one, yet I hesitate to press it. To show that a writer's assertions are inconsistent is not to disprove them, and the scoring of purely logical points is apt to irritate the reader, particularly the English reader, more than the writer against whom they are directed, especially if he is Mr. Huxley. For the charge of inconsistency is one which quite peculiarly fails to wring Mr. Huxley's withers. On the contrary, he glories in it. "For me the pleasures of living and understanding have come to outweigh the pleasures . . . of pretending to be consistent. . . . Therefore I indulge my inconsistencies," "investing myself at the same time with an invulnerable armour against critics"—he might have added, but refrained.

Forbearing to press the logical point, I cannot leave it without asking Mr. Huxley to draw for my benefit a distinction between philosophy and science.

Science, it is clear, escapes the gravamen of Mr. Huxley's indictment. It does not, like philosophy, attempt to prescribe to reality; it is content to record it. Modestly it observes facts, and predicts other facts not yet observed. Certainly it does; but is this all that it does? Certainly not! Science works up its observations into general formulæ, reasons about them, and draws what purport to be universally applicable conclusions. Biologists, for example (many of them), tell us that acquired characteristics cannot be inherited; physiologists (most of them), that an entity called the soul does not leave the body at death; psychologists (some of them), that mind action will ultimately be completely interpretable in terms of brain and nerve action, of which it is a determined function; bio-chemists, that there is no line of demarcation between the living and the non-living. These conclusions may or may not be true. But how are they reached? By process of ratiocination upon the evidence supplied by the senses. But, if the scientist spends, and rightly, much of his time in inferring the nature of what has not been observed on the basis of what has, if he goes further and generalises about the characteristics of certain departments of reality not completely explored and the capacities and limitations of certain entities not yet completely catalogued, by what right does he escape Mr. Huxley's strictures? Is he not like the philosopher prescribing to reality in the interests of his own predilections and, when he goes beyond the immediate evidence of his senses, using his reason to invent arguments for

what he instinctively wishes to believe? But, Mr. Huxley will say, the scientist's conclusions can be verified, the philosopher's cannot. But how if the scientist unconsciously cooks the evidence which is required to verify his conclusions? I shall return to this point later.

Now it *may*, of course, be the case that all our beliefs are the offspring of our instincts, and that thinking is to be explained by the fact that we have an instinct, one of the strongest, to find reasons for what we instinctively wish to believe. If this is the case, if we are always constrained by our dispositions and never by the evidence, we are none of us immune, and the scientist sins no less than the philosopher. But is it? I do not think that it is, and in saying so I come to the main point at issue.

§ 2

Mr. Huxley's article contains a criticism of two rather different philosophical positions, that of the rationalists and that of the mystics. Each purports to be a way of obtaining truth about the universe: Rationalism asserts that you can reach truth by process of correct reasoning from premises perceived to be self-evident; Mysticism by process of direct revelation. Mr. Huxley fails always to distinguish these two positions, and it is not always clear against which of them his criticisms are being levelled. In fact, however, they are sufficiently distinct, and may be opposed. Pascal, for example, as Mr. Huxley points out, denounced Rationalism and affirmed the validity of mystical revelation. Personally I think the opposition a false one, as I shall try to show, but it will be convenient to take each position separately and to see how far it can be defended against Mr. Huxley's somewhat indiscriminate charge of vicious subjectivism.

Rationalism, it is clear, assumes that the universe is reasonable; if it were not, reasoning would not help us to understand it. Now Mr. Huxley says bluntly that it is not: "What," he asks, "is the final, the theological reason for grass being green and sunflowers yellow?" Admittedly there is none. "Grass," he says, "is green because that is how we see it; in other words, it's green because it is green." Mr. Huxley proceeds to infer that what is true of the greenness of grass is true of all the other characteristics of the universe. Things are green because they are; similarly they are agonising or pleasant, holy or

shameful, beautiful or ugly, because they are, and that is all there is to it. The universe for Mr. Huxley is all of a piece, and if you want to know what it is like, you must go and look. Inevitably, since, if the universe is irrational, there is no other way. All our knowledge, in other words, comes to us through sense experience, and is limited by sense experience.

Now this is simply not true. Some of our knowledge does not come to us through sense experience. It may, of course, be illustrated by sense experience, and *some* sense experience may be necessary before we realise that we have it, but it is other than the knowledge given to us by our senses and outruns it. It is this knowledge that we call *a priori*, and by it rationalists have set store—naturally, since it is only reason that can give it to us, and of what is reasonable that we can have it. Mathematical and logical knowledge are pre-eminently of this character. That two sides of a triangle are greater than the third, that two plus two make four, that the whole is greater than the part, that if P implies Q, and Q implies R, then P implies R, that A must either be A or not A, these are general propositions which are true ; and that they are true is known otherwise than through the senses.

Sense experience, no doubt, is necessary to draw our attention to them. The child plays with bricks and beans, takes two pairs, puts them together and counts four. The particular truth must be realised on a number of occasions before the general one is grasped. But once this has been done, it is realised that the truth that two and two make four is true not only of the particular objects counted, but of all objects in the universe, both those which have been counted and those which have not ; not only of those things which exist in the present, but of any things that may come to exist in the future ; in short, of any things whatever. What is more, even if no objects existed, even if, that is to say, there were no particular things for us to experience and for it to apply to, the general proposition that two plus two make four would, it is realised, still be true and could still be known by mind. Thus, though sense experience may be necessary to draw our attention to the truth, the truth itself is seen to be independent of such experience. It is not, therefore, by means of sense experience that it is known. How then ? Presumably by our reasons. The proposition once grasped is seen to be necessary and inevitable. Our reasons could not conceive it otherwise ; therefore it is ; it is a fact.

That such knowledge exists is obvious. The point is an elementary one and should not require stressing were it not that Mr. Huxley seems to have overlooked it. Overlooked by Mr. Huxley, it was embraced with acclamation by the rationalists. Impressed by the fact that there were some truths about the universe which were directly apprehended by reason, and for the trustworthiness of which the testimony of reason was a sufficient guarantee, they proceeded to assume that all our knowledge was of the same character, that all the characteristics of the universe could be discovered by the same method.

Now if the universe were like a mathematical problem, the assumption would be justified. Just as a mathematician sitting at his desk could, provided he reasoned well enough, deduce the whole of mathematics from a few self-evident propositions, so the philosopher at ease in his chair could, provided he philosophised well enough, arrive at the complete truth about the universe by meditating upon the nature of his own experience. Inferring the nature of what is from the nature of what must (according to reason) be, he would be absolved from the necessity of checking his results by experience. It would be unnecessary, in other words, for him to go and see whether the universe which he had inferred was in the least like the universe that is. Many philosophers have in fact proceeded on these lines and with the distressing results which Mr. Huxley justly derides. Meditating in their arm-chairs they have produced maps of the universe on which nobody else has been able to find his way. Inevitably, since the maps were maps not of the universe but of the philosophers. Like Mr. Huxley, these rationalist philosophers have assumed that the universe is all of a piece. Unfortunately the universe is not like a mathematical problem, and the method of Rationalism, admissible in the realm of logic and mathematics, fails completely to tell us what exists in the world of fact, " What I clearly and distinctly conceive is true," said Descartes. Very likely, but it does not therefore exist. There is no reason whatever why a substance with the specific gravity of gold should be yellow. Hence we cannot discern the fact by reasoning ; we must go and look—in other words, we must follow the method commended by Mr. Huxley. We arrive, then, at the conclusion that, so far as the world revealed to sense experience is concerned, neither Rationalism nor any other philosophy can tell us what it contains. If we want to know, we must experience it.

But it does not therefore follow that Rationalism is valueless, and it does not follow precisely because the universe is not all of a piece. Herein lies Mr. Huxley's mistake. Seeing that there is nothing reasonable about the fact that grass is green, he infers there is nothing reasonable about the fact that the whole is greater than the part. He is wrong. The truth of the matter is that certain regions of the universe are separated by real differences in kind. There are, in short, to put it crudely, two worlds. There is, first, the world of sense experience ; this is the home of irrationality and contingency, and its contents can only be discovered, if at all, by inspection ; and there is, secondly, the world of necessity, the home of reason, the nature of which is revealed in thinking to mind. The experience of our senses will no more provide us with information about this second world than reason can inform us of the characteristics of the first.

What are the contents of this second world ? Here we enter the realm of controversy. Many, as I have said, have considered it to be all-inclusive, and proceeded to impugn the reality of the arbitrary, haphazard fact which refused to fit into it. Rejecting the view that the universe is reasonable throughout, we may still ask whether the second world is limited to the facts of sense experience on the one hand, and the realms of logic and mathematics on the other. What of ethics and æsthetics ? At this point we must make a confession. Many, perhaps most philosophers—and I hope that it will not set the reader against them—have claimed that Goodness and Beauty must, with Truth, be included in the second world. Mr. Huxley denies this claim. Beauty, Goodness, and Truth are for him fictitious noumena invented to gratify human desires. How are we to make it good ?

Here arises a difficulty. That there is a distinction between the two worlds I affirm, and Reason, I affirm further, can give us true information about the second. But how are we to draw the line between them ? Reason alone, it is clear, can draw it. Hence Reason is in the position of being both judge and jury in her own course.

Assuming complete domination over the second world, claiming it as her own, she arrogates to herself the right to prescribe its boundaries. The position seems unsatisfactory, for Reason, when pressed to show cause why this or that should be included in her world, seems unable to produce her title deeds. There

is, in other words, no proof that certain propositions which are known *a priori* are true and assert facts which are real, and only proof, it seems, will give Mr. Huxley satisfaction.

But there are many things which Mr. Huxley accepts without proof, the validity of inference for example. All reasoning, it is obvious, depends upon the principle of induction. If I am not entitled to assume that the more frequently A and B have been found together in the past the greater the probability that A will be accompanied by B in the future, if, applying this principle, I am not entitled to infer A from B, or say that A follows from B, or to affirm that A is implied by B, I cannot reason at all, for a chain of reasoning is nothing but a set of inferences. Not only can I not reason, I cannot live. The gong rings for dinner, and I descend to the dining-room. Why ? Because the dining-room and food having been frequently found in association in the past, I infer that they will be so associated in the future. If I did not unconsciously make this inference, I might just as well ascend to the roof or stay where I am. In either event I should not eat, and if I do not eat I die.

The legitimacy of inference is assumed, it is clear, not only in reasoning, but in every moment of our daily life. We think on the assumption that it is valid, and we act on the assumption that it is valid. But how is its validity to be established ? Certainly not by reasoning, for that would be to assume the validity of the very principle that it is required to prove ; nor by sense experience, for inference is implied in the fact that we have such experience, enabling us, for example, to work up the chaos of sense-data of which our senses make us aware into a coherent world of chairs and tables. It seems, then, we have got to assume it. Reason again is both judge and jury in her own cause. Asserting that she is unable to function unless she is allowed to infer, she gives herself permission to infer.

The truth of the principle of induction—it is a nettle we must grasp sooner or later, and we may as well grasp it now—is, in fact, revealed to insight. We just see that A follows B, and that is all we can say. Does Mr. Huxley, therefore, doubt the principle ? Not at all. It is rampant throughout the whole of his closely reasoned essay. But if the principle of induction, upon which the whole structure of reasoning rests, is revealed to insight, may not other things be so revealed ? What other things ?

To answer we must return to the presence of Truth, Goodness, and Beauty, the three dowagers of philosophy. Mr. Huxley has been rather rude to them; but they are venerable antiquities, and I should like to say something to preserve their reputations. To do so I must tackle Mr. Huxley on the subject of mysticism.

§ 3

Let me begin by summarising the conclusions I have reached. First, there are some truths which cannot be proved; they are nevertheless true. For these truths it is inadmissible to demand evidence, for they are self-evident. They are, that is to say, simply seen to be true and unquestioningly accepted as such. Among them is the truth of the principle of inference or induction, which Mr. Huxley accepts.

Secondly, since all reasoning rests upon the principle of induction, reasoning has an irrational basis. Not only is the general principle accepted without proof, but each step of the argument in which the principle is involved is similarly indefensible. At each step in a chain of argument we either see that A follows from B or we do not. If we do not, no arguments can be brought forward to convince us which do not themselves involve similar acts of insight, which do not themselves, that is to say, involve an acceptance of some step similar to that questioned.

The words "acts of insight" are used deliberately because they lead to my third conclusion, that there is an element of direct revelation in all thinking. We either see things or we do not. It follows that, since we undoubtedly reason, and sometimes correctly, there can be no objection on principle to the acceptance of truths instinctively apprehended or revealed to insight. The principle of direct revelation, in other words, may be accepted as a method of arriving at truth.

We are now in a position to take up the cudgels on behalf of the dowagers.

Enough has, I hope, been said to show that no strictly rational defence is possible. Like other dowagers, Truth, Goodness, and Beauty are not reasonable. But having agreed that there is nothing against them on principle, let us see what considerations can be advanced in their favour. They are mainly negative. If we cannot positively vindicate the actuality of the dowagers, it is at least possible to show that most of the attacks that are

made upon them are baseless. If we cannot prove that Goodness, Truth, and Beauty exist, we certainly cannot prove, as Mr. Huxley seems to think, that they do not. Let me begin by stating, as I understand it, the precise point at issue.

Certain phenomena of which we are conscious in ethical and æsthetic experience have seemed to many to be explicable only upon the assumption that there are in the universe certain absolute values, Goodness and Beauty, with which the phenomena in question are intimately connected, and from which they derive their significance. Those who have taken this view have tried to show that the assumption of the reality of these values provides the only coherent and intelligible account of the phenomena, and that to that extent their existence is demanded by reason. In the last resort, however, they have admitted that these objective values are revealed only to direct insight or intuition, which in their most satisfying and authoritative forms are vouchsafed to us in mystical vision. Against them it is urged by Mr. Huxley that these absolutes are subjective figments projected by our minds into the external world. They are not, therefore, in any sense independently real. The dowagers, in short, are merely Mrs. Harrises.

In the first place, we may ask, what is the precise significance of the word "subjective" as it is used in this connection? Presumably, that if the assumption of an entity can be shown to answer to a need of the human spirit, it can be inferred that the entity in question is a product of the spirit that needs it. We need, as Mr. Huxley says, a noumenal world more truly real than that of everyday life. Therefore we falsely assume that it exists.

But things are not quite so simple as that. Although the need is subjective, the situation in which it arises is not. Man's consciousness is no isolated and arbitrary phenomenon in the universe, but, as Mr. Huxley would be the first to admit, a biological growth moulded by its past and bearing the impress of its origin plainly upon it. What is true of man's consciousness is true also of the needs of his consciousness. These, too, have their roots in the past, are determined by man's ancestry, and conditioned by his environment. Presumably, therefore, they reflect the factors that condition them. Now man's ancestry and his environment, together with all the influences which have gone to make him what he is, are not subjective, but objective. They constitute the external situation in which

his consciousness and the needs of his consciousness arise, and to which they respond. This external situation is a real factor in the universe. Hence man's needs, instead of being subjective phenomena, in the sense in which what is subjective is arbitrarily so, spring from and reflect real factors in the universe. There is, therefore, reason to suppose that, when these needs are so widespread as to be almost universal, the sort of universe to which they point has a definite relation to the universe from which they sprang. It would indeed be strange if a need which was demonstrably the product of a real situation should be devoid both of point and significance, and own no objective counterpart in the universe which gave it birth.

Secondly, it is important to realise precisely how much and also how little the argument from the origins of human needs proves. On this point there is much current misconception. Tracing the beginning of the æsthetic consciousness in the emotions and of the moral consciousness in the social observances of primitive tribes, people argue as if in so doing they had somehow discredited or invalidated the æsthetic and moral consciousness. It is not clear why. If the doctrine of evolution is to be taken seriously, we are surely entitled to hold that there is more in the evolved product than there was in the germ from which it may be shown to have arisen. Why should this doctrine not apply to the phenomena of the developed human consciousness? To show that religion began as Totemism and Exogamy does not prove that it is not religion, that is to say, something very different now, any more than the discovery that the savage can only count on the fingers of one hand invalidates the multiplication table. To know that Einstein was once a fish and still possesses the rudiments of gills tells us very little about the mind of Einstein now. To judge a thing by its fruits is as relevant to an estimation of its true character as to judge it by its roots. It is as important, in other words, to know what a thing is aiming at as to know how it began, and no account of it which, taking cognisance of its origin, proceeds to interpret its present nature solely in terms of its early history, can pretend to be complete. In any event it cannot be too strongly emphasised that to lay bare the origin of a thing is not tantamount to discrediting it. The point should be obvious, yet Mr. Huxley often argues as if the fact that savages have believed in God constitutes a sufficient ground for regarding God as a figment, just as in

writing of Pascal he seems to think that by showing that Goodness, Truth, and Beauty reflect present needs, and that these present needs have developed by a continuous process from savage ones, he has somehow proved Goodness, Truth, and Beauty to be unreal. Because everybody believes and has always believed in something, the belief admittedly is not therefore true ; but equally it is not therefore false.

Thirdly, we are entitled to ask by what criterion of reality that of the dowagers is impugned. If they are not real, what is ? As far as I can gather, Mr. Huxley's answer—as it is certainly the answer of many similar critics—is that the physical world of which our senses make us aware is real. So much so indeed, that Mr. Huxley often writes as if the world of material objects and the mind which knows it are the only types of reality that exist. Nothing that is not matter or mind—and even mind may turn out to be merely a function of matter—is for them real. I am surprised that Mr. Huxley should subscribe to this unduly simple notion of reality. He seems to pride himself on taking a common-sense view of reality, unaware that common sense is merely a mass of dead metaphysics, and its beliefs the debris left by the philosophies of the past. Yet he should know —no one better—that there are very good reasons indeed for denying that the everyday matter-of-fact world has any existence independent of ourselves. And he does know it, for he tells us in his article that mind may be the creator of matter, and flirts engagingly with the Solipsist hypothesis that we never know anything except our own mental states. Admitting so much, how can he bring himself to employ the so-called " reality " of the sensible world known to us in perception as a stick with which to chastise the dowagers ? Unless we are prepared to take an extremely naïve view of perception, for which modern science holds no brief, it is not in the external world of daily experience that we are to find the objective reality which is denied to revealed values.

Nor is it merely an agnosticism that modern science professes as to the nature of the objects of our perception. If it were, the case from Mr. Huxley's point of view would be bad, but not so bad. But science does not assert that it cannot tell us what is the nature of the reality of that which we perceive. On the contrary, it detects, and with increasing unanimity, in the apparently neutral objects of everyday experience, precisely what Mr. Huxley detects in the world of spiritual values, namely

ourselves. The modern scientist, in fact, has made a belated discovery of the uses of Idealism, and is surprised to have to announce what most philosophers could have told him all along, that his so-called external world is a projection of himself. We only know our own ideas and sensations, said Locke, Berkeley, and Hume ; the external cause of these ideas and sensations is unknown to us, said Berkeley, Hume, and (with reservations) Locke, and must be presumed to be God (Berkeley) or non-existent (Hume). We know only the phenomenal world, the product of our own mental categories, said Kant. Things as they are in themselves, if there be such, we do not know.

Emanating merely from philosophers, these assertions attracted little attention. It is only since the voices of the physicist and the psychologist have been raised to swell the idealist chorus that the part which we ourselves play in constructing our own perceptual world has been generally conceded. To many psychologists the advance of psychology seems to yield continuous evidence that the farther we go in analysing the objects of our consciousness, the more do we find ourselves. " We make our own world," says Havelock Ellis ; " when we have made it awry we can remake it approximately truer. Man lives by imagination." And Vaïhinger has urged that just as the digestive system breaks up the matter which it receives, mixes it with its own juices and so makes it suitable for assimilation in the practical interests of the organism, " so the psyche envelops the thing perceived with categories which it has developed out of itself." Thus our consciousness is no guide whatever to the physical happenings, if any, outside our skins.

The physicist is in substantial agreement. The theory of relativity, for instance, has much to say of the mental factor in scientific explanation. The physicist's world is a spatio-temporal flux of events whose characteristics are confined to severely mathematical properties. Upon them the mind imposes, or from them it selects (accounts differ) certain patterns which appear to possess the quality of comparative permanence. These patterns are worked up by the mind into continuing objects, and become the chairs and tables of daily life. But, as they are modelled by the mind, so do they reflect the needs of the perceiver. Different minds with different interests, those of Martians for example, selecting different patterns would " perceive " different worlds. " All through the physical world," says Eddington, " runs an unknown content, which

must really be the stuff of our own consciousness. . . . We have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature."

Is not the language familiar? Do we not recognise the authentic subjectivist note? *Mutatis mutandis*, the words might be those of Mr. Huxley revealing the human origin of absolute values. Human in origin they may be, but, if they are, chairs and tables are in the same case, and for the same reason.

Does Mr. Huxley deny the reality of chairs and tables? Apparently not! Matter, he says, " whether we like it or not, is always there." With what logic then does he deny the reality of absolute values formed apparently by the same process of mental projection? The difference between a chair and a philosophical dowager is merely the difference between the ways in which our experience is organised. We organise our sensory experience and produce the world of material objects which science explores; we organise our spiritual experience, and, behold, the dowagers Goodness, Truth, and Beauty, about whom philosophers reason and whom mystics enjoy. Whatever grounds there are for impugning the independent reality of the second world are equally valid against that of the first. But if, rejecting these grounds, we hold that what we perceive by the senses is objectively real and exists independently of our experience, then what we perceive by the spirit is equally so. Personally I do reject them, but that is another matter which cannot be pursued here. I mention it only to explain my support of the dowagers.

But Mr. Huxley has a further point, the last which I shall take up. If we were to assume provisionally that absolute values are real, that they are independent of ourselves and not projections of ourselves, then he says we could not know them. Why not? " The revelations," he says, speaking of mystical experience, " are couched in human language and are the work of individual human beings who lived all too humanly in space and time. We are fatally back again among the relativities." This seems to be a simple confusion between the revelation and its object. Granted for the moment that the object, though revealed to insight, is independent of it, that it is discovered not created, then the fact that it is described in human language is no ground for inferring that

it itself is human. The mystic, no doubt, talks nonsense ; at least it is nonsense to those who are not mystics. But how could it be otherwise ? Language was invented to describe the objects of one world, the world of sense experience, and to communicate its happenings. It is clearly inappropriate to the objects of another. If there is a world of absolute values, any attempt to discourse of it in the language of everyday life must of necessity be misleading ; at any rate it will mislead all who have not shared in some degree the experience to which it relates. I cannot, for instance, convey by means of words the experience of a toothache to one who has never had it ; but that does not mean that my toothache is not real, and the fact that the mystics' accounts of the dowagers are vague, and flowery to the nth degree, gives no reason for supposing that the dowagers have not been viewed. If mysticism could give an account of itself, it would cease to be mysticism.

Mr. Huxley's language at this point is itself confused, but I am inclined to think that it conveys a suggestion to the effect that if the inhuman and perfect existed, the human and relative could have no intercourse with it. I agree that it could not, if intercourse implied continuity of substance and community of being. The perfect, it is clear, could not enter into communion with the imperfect. But why should the relationship imply communion in this sense ? One does not after all have intercourse with dowagers. But one can contemplate them. A cat may look at a king, and a mystic at a dowager, and neither the king nor the dowager is any the worse for the experience. They are probably unaware of it.

Russia and European Civilisation

A. Lobanov-Rostovsky

RUSSIA seems to possess a peculiar faculty for exasperating Europe. In the nineteenth century when Europe was seeing in liberalism and parliamentarism the last word in social progress, Russia stood out as the stronghold of "despotism," and now in the war-ridden continent which is cautiously proceeding to reconstruct its badly shattered civilisation, that country has emerged as a champion of destructive theories. Thus it has passed from the extreme right flank of the social front to the extreme left, and in both cases appears in Europe's political life as an immense and awkward force, ill-fitting and dangerous. This lack of synchronisation between the development of Russia and the progress of Western Europe has accounted for endless trouble and friction. There are deep historical and psychological causes which explain it, and these must be examined carefully if we would estimate the place assigned to Russia in world affairs. The importance of this place may be appreciated not only by the rôle played by the diplomacy of that country throughout the nineteenth century, when at times such as between the Congress of Vienna in 1815 and the Congress of Paris in 1856 it took the lead in the concert of Continental Powers, but also by the fact that of the many revolutions which have troubled the earth since the beginning of this century, the Russian Revolution alone assumed the proportions of a world event. Indeed, the Portuguese Revolution which preceded the War, and the German, Austrian, and Greek Revolutions following the War, have affected only their respective countries. In Asia it is the same; the Turkish and Persian Revolutions have been of strictly local interest. Of more importance to the world are the events in China. The Chinese have called their revolution "Great." Though it is difficult for Europeans to understand the meaning of a monotonous succession of civil wars spread over two decades, it must be acknowledged that both the importance of changes introduced into Chinese life and the size of the area and population affected, to some extent warrant this appreciation.

But alone in Russia from the very outset of the Revolution, while the more moderate elements were thinking in terms of national problems, the more extreme sections, which gradually

paved the way for Bolshevism, were already endeavouring to place it on the wider plane of a world social problem. Still, in the days of Kerenski the newly-born Petrograd Soviet was already broadcasting wireless messages to "All-All-All," in other words, to humanity at large. And though the sanguine expectations of the Soviet leaders that a new era for the world would be inaugurated with their advent to power has remained unfulfilled, still the perturbations that Bolshevism provoked in Europe during and after the War, the unrest which though evaporating is still existent to-day, the fact that it gave birth to a contrary social current of great importance—Fascismo—and last but not least the reactions which are only now becoming visible in Asia, suffice to justify the claim that the Russian Revolution has been a major event in the history of mankind.

Russia has thus assumed the rôle of a generator sending forth strong electric currents into the field of a world in reconstruction. The important question which arises is whether this action is limited to the unhealthy appeal of Communist slogans to elements which have lost their previous balance, or whether potentialities are developing which will maintain this influence even when under the dire pressure of life the Soviet leaders will be obliged to discard completely their credo. As Bolshevism is already rapidly evolving and is obliged to abandon one after another its previous positions, this is a question of actuality. To find an adequate answer we must analyse the complex personality of the Russian nation, as made up of various historical strata, each of which has left its mark and sown a harvest of potentiality. We must further differentiate between the possible influences exercised by Russia upon Asia and by Russia upon Europe.

Russia has had an exceptionally chameleon-like destiny, and in the short period of a thousand years she has appeared under five completely different aspects: the original European with strong Northman influence, the Byzantine, the Asiatic, the Western with strong German influence in the so-called St. Petersburg period, and the present Soviet. This last is largely a compound of the previous ones, and is explainable either as a result of these or as a reaction to their too pronounced idiosyncrasies. Consequently when the Soviet leaders claim to have inaugurated a new era in Russia they overlook the fact that Bolshevism was made possible only by the special historic development of Russia, and that the past had not only shaped

the material upon which they are experimenting but it is also greatly affecting the outcome of these very experiments. If therefore we want to get a clear view of the drift of present-day Russia we have to study not only the developments of the present times but also to consider those active forces which have been left as a residue from earlier historical periods and which either affect the making of history directly, such as for example the religious factor inherited from Byzantium, or indirectly such as memories of serfdom or of the Tartar yoke and the domination of Asia.

For nations as for individuals early memories of infancy stamp their future ineffaceably ; witness the mark left upon Latin countries even until to-day by memories of Rome. It must therefore be remembered that in the first three centuries of her existence, namely from the ninth to the twelfth centuries, Russia was considered a member of the European family on equal terms with any other country of the West. King Olav Trygvason of Norway was as a matter of course educated at the Russian court, and the daughters of the Grand Prince Yaroslav of Kiev married into the royal houses of France, Hungary, and Norway, one of these princesses dying with her husband at Stamford Bridge.

Kiev itself became one of the most brilliant cities of Europe, rivalling Constantinople in its somewhat ephemeral glory. Whatever later may have been the vagaries of Russian history or may be in the future, we must bear in mind that this is the first and basic strata in the psychology of the nation.

But it was the second strata, of Byzantine origin, that was the deciding element in the formation of Russia. Byzantium not only gave Russia its religion and its civilisation by introducing the glagolitic script still in use to-day, but it did more ; it shaped Russia's soul for a thousand years to come, and its influence, far from diminishing as the centuries progressed, increased and reached its climax, as will be seen in the late nineteenth century, that is to say, just before the Revolution. It is impossible to understand Bolshevism without taking the Byzantine factor into account. But by having been drawn into the orbit of Byzantium, Russia shared with the latter her gradual estrangement from Western Europe, brought about by the separation of Churches and by the development of an original Byzantine civilisation as distinct from Rome. This estrangement became so great as to enable the fourth crusade in 1204 to be diverted from its object to the sacking of Constan-

tinople. Similarly in 1236 the Pope blessed the crusade of Jarl Birger of Sweden against the Russians, which however ended disastrously for the Swedes, and the deeply religious Russians of that day attributed their victory to the divine intervention of our Lord in favour of Orthodox Russia. It is therefore from these distant days that may be traced the feeling of hostility ever since noticeable in one form or another in the relations between Russia and the West. Consequently Europe witnessed the great tragedy of the Tartar invasion with the same remote indifference with which she later saw the destruction of Byzantium by the Turks. Russia was detached from Europe by this invasion, and from then on lived on the memories of Byzantium and the grim realities of the domination of Asia. When in the days of the Renaissance she again emerged before the astonished eyes of a Europe who had forgotten her, she was garbed as a semi-Asiatic Muscovy. Then Peter the Great attempted in the short time of one single generation to bring the nation completely back to Europe. But he did not realise that the model he had before his eyes was not static but rather in full motion. While by his titanic energy he was forcing the pace of evolution in his land, Western Europe herself was embarking on a period of rapid transformation. Therefore when Russia, exhausted by the violent effort of catching up with Europe of the eighteenth century, needed a rest to find a new balance for the forces which had been disturbed by this revolution, the goal itself, i.e. Europe, was shifting away with increasing rapidity along the path leading to industrialisation and integral democracy. The result was that when Russia resumed her onward movement she started with an increasing handicap, and the gap between Western Europe and Russia became, as time went on, not smaller but gradually larger and larger. Indeed, Russia of the eighteenth century was nearer to the militarised Prussia of Frederick the Great, or to Austria, who also had still not freed herself from serfdom, than Russia of the Crimean War was to Victorian England or the France of Napoleon III. The timid and unwilling parliamentarism of Nicholas II was still further from the democratic constitutional monarchies of pre-War days.

This allows us to establish the exact measure of the "westernisation" of Russia from Peter the Great up to the Revolution, and to see in what way this process was affected by the advent of the Soviets. As we have seen, the reforms

of Peter the Great brought Russia abreast with Western Europe for a short time only. What he did do was to rid Russia of those Asiatic influences which had crept into her history through the accident of the Tartar Invasion.

These must not be overestimated, for much in Russian life that was Byzantine in origin and consequently differed from the West was attributed by superficial observers to Asia. It must be remembered that the Russians always had a religious horror of the Tartar invaders, who were looked upon as heathen and "unclean," and the battle of Kulikovo (1380), which brought deliverance from them a century and a half after their invasion, was celebrated up to the Soviet Revolution. The Tartars on the other hand, vastly more concerned with building up their great Asiatic Empire, looked upon Russia as a distant and uninteresting colony. They settled down in the deserted lower Volga regions hundreds of miles away from any centres of Russian civilisation and did not interfere with the inner life of the country, except for annual armed raids to collect taxes, and the institution of a mandatory system of power to the Russian princes when they became too quarrelsome among themselves. Under such conditions no moral contacts between the invaders and the people of the country was possible. The influence exercised by the Tartars in Russian history reduced itself, therefore, to the isolation of Russia from Western Europe and the shifting of her centre of gravity towards Asia. Consequently the oriental strains in the imported Byzantine civilisation were stressed, and Russia's contacts with Asia magnified them just as a violin box intensifies the sound sent forth by the chord. On the other hand the journeying of Russian princes to the Tartar headquarters for their mandates served to discover the unknown East and prepared for Russia's Asiatic expansion.

Thus Peter the Great succeeded in ridding Russia of the dead weight of this past, and by giving her a modern technical equipment brought her abreast with the Europe of his days. But as Europe outdistanced Russia in the race towards democracy, Russia stabilised on a middle position between the two continents which was precisely the position previously held in the world by Byzantium. The Byzantine imperial idea, which had been preserved through the Tartar domination as a result of the seclusion from Europe, was the moral stimulus which created a united Muscovy, and its continuous growth may be traced from the overthrow of the Tartars in 1380 up to Peter the Great. But it was

through the strength and majesty given the State by the modernisation of its equipment that this idea from now on up to the Great War attained full fruition. Russia assumed the mission of Byzantium as protector of the Greek Christianity and as intermediary between the West and the East. She further modelled herself on the Greek prototype, and indeed the resemblance in the constitutions of the two empires was striking. Though not represented with a halo around his head, as was the custom for the Basileus in Byzantium, the Tsar assumed the same title, " autocrator," and is supposed to be anointed at the coronation and receive divine grace. The Church, a strong and independent political factor in old Russia, was reduced by Peter the Great to become, as in Byzantium, an instrument of the State. In the sphere of administration we find in the nineteenth century the Russian Council of State, which may be compared to the Byzantine Senate, and the division of the country into administrative units resembling the Byzantine Eparchies and Themes. The culminating point in the development of Byzantinism in Russia may be considered to be at the end of the nineteenth century, when in the reign of Alexander III, father of the late Nicholas II, the nearest to what was termed in Byzantium " Cesaro-Papism " was reached.

Consequently the present revolution in its original aspect may be viewed as a reaction against " Byzantinism." It was fostered by a desire to bring Russia again abreast with Europe and fill the gap which two centuries had made, but without destroying the national and historical background of the nation. However, when power came to men who had embraced the extreme theories put forward in the West, they set themselves the task of destroying and stamping out all the elements of Russia's past. Consequently the Byzantine idea which had been the moral backbone of the nation all through Russian history, was broken. What has taken its place ?

The Soviet Revolution may from another view-point be seen as the final outcome of the process of westernisation undertaken by Peter the Great, when logically developed *ad absurdum*, for the interests of the Communists lie so completely in the West, and they are so absorbed by their ideal of revolutionising the West, that they have sacrificed the interests of their own native country to this task. Marxism, and the scientific outlook evolved in the Occident, come first with the Soviet leaders, and Russia second, just as with Muscovy the Orthodox

religion came first and the country second. This inverted mystic creed of Westernism has led them to override the obstacles presented by historical national idiosyncrasies, and in their attempt to overcome them they have been compelled to destroy precisely those classes in Russia imbued with Westernism. The Revolution has thus actually become an instrument for detaching their country from Europe. [The final result has been a double centrifugal tendency resulting from the disappearance of the stabilising medium line.] From a practical standpoint this dangerous split in the moral basis of the nation has, oddly enough, served the purpose of the Soviets very well, for it has enabled them to show to their European supporters a European face (all the more easily because their propaganda affects comparatively uneducated classes), and to Asia, either a European face for the benefit of the native Europeanised intelligentsia or an Asiatic one, if circumstances demand it. Thus they make the best use possible of Russia's intermediate position.

But in the meanwhile the process of the Europeanisation of Asia itself has gone so fast that the Russia of to-day is faced with a situation unknown both to the Russia of the nineteenth century and to Byzantium, in its rôle of intermediary between the West and the East. The Pacific coast of Asia under the combined pressure of Europe and America is changing so rapidly that it has outdistanced Russia in the process of Westernisation. This refers mainly to Japan, and the comparison of its evolution with the slower process undergone by Russia is not only deeply instructive but affords some explanations as to the peculiarities of the Soviet regime. Japan achieved such outstanding success in rebuilding her life on a Western pattern that she appeared without any difficulty to march in step with Europe. Already a quarter of a century ago she appeared in some respects more "Western" than Russia, and that is one of the main reasons why European sympathy went to her during the Russo-Japanese War. That war presented the odd spectacle of an Asiatic Power equipped with a European political structure fighting a European Power who was obstinately refusing to accept this same structure. But if this result was achieved owing to the genius of the Japanese for imitation and their amazing sense of discipline, it must also be said that it was achieved at a very great cost, namely, the renouncing of their older civilisation. What

Byzantium was to Russia, China directly or indirectly through Korea has been to Japan.

Whereas in Russia we have seen Byzantinism thrive after the reforms of Peter the Great, in Japan the Emperor Reformer Mutsu Hito was compelled to make a clean sweep of the past inherited from China and start the national life afresh on European lines. In Russia contrariwise there was no break in the cultural tradition, and "Westernism" was merely grafted with slower but surer results on to the old deeply rooted national tree. This continuity made the growth of Russia up to the War organically healthy, and she was well on the way to building up a sane and vigorous culture of her own when the great squall came. However, it is owing to this fact that Russia survived the terrific double impact of the War and Revolution and digested the deadly virus of Bolshevism. We see indeed the unpalatable theories imported from Germany gradually change their appearance in the boiling cauldron of the perturbed Russian life and the Soviet regime gradually transforming itself into something specifically Russian. If the Byzantine ideal is shipwrecked, the imported ideology of integral Marxism is obviously bankrupt. Consequently the rapid internal evolution of Soviet Russia is nothing but a gradual readjustment to the country's real atmosphere and needs. In this process of readjustment to reality under pressure of life, those factors of the past which form a perennial element of the nation's moral capital, and therefore could not be destroyed but were merely submerged, are gradually reasserting themselves. These are gradually blending with the values created by the Revolution, which have proved by the test of time that they have come to stay. Thus the final equation of the new Russia will be made up of the elements of the past and those of the new life which have withstood the cleansing effect of time which has mercilessly swept away all that was worn out in the past and all that is utopian in the present. Thus we may see a modified Soviet constitution surviving, by discarding the Communist programme.

So far we have considered Russia only as an old country. But at the same time we must take note that Russia is the only country in Europe which is building up a new civilisation on a virgin soil by a process similar to that going on in the United States and in Latin America. It is this curious duality which makes her so anomalous. Like the United States she has had her great waves of colonisation moving into new lands,

only going mainly east instead of west. Like the United States she has mushroom cities springing up all over her territory. It must be remembered that the former capital St. Petersburg is the youngest great city in the world with the exception of Chicago; it is younger than Rio de Janeiro, New York, or Buenos Ayres. In the south, the great port of Odessa dates only from 1792. The whole of this vast Black Sea region, where such thriving commercial cities as Rostoff on Don are to be found, was, only a little more than a century ago, a wild steppe, the abode of nomads. To-day this is one of the most fertile regions in the country and the great industrial centre of the Donetz mines. The American newness of this part of Russia is to be seen by the planning of cities in chess-board patterns with the streets at right angles. Farther east we find more conspicuous examples of this process; such as the transformation of the city of Batum from a dirty and neglected Turkish village dating only from the war of 1877–8; the rise of Baku; the springing up of modern Russian cities in Central Asia, such as Tashkent, Khokand, and Samarkand, close to the native towns, dating from the conquest in the sixties; and in the far East the founding of Vladivostock at approximately the same time. Innumerable townships have sprung up all over Asiatic Russia as a result of the construction of the Transiberian Railway and the linking by rail of Turkestan with Russia in Europe, through Orenbourg.

This colonisation by Russians of the outlying portion of the vast Empire resulted not only in the increase of the economic might of the country but also in the unification of these various regions under one culture, and at least as far as the Asiatic or semi-Asiatic populations are concerned the Russian cultural influence had had a powerful and all-absorbing effect. The process is particularly important to-day, for on one hand the Soviet regime, by definition, stresses the modern aspect of Russian life at the expense of historical traditions, while on the other the gradual resumption of the enormous increase in the Russian birth-rate gives a new vigour to this expansion. There may appear a certain contradiction between this fact and the newly evolved autonomic tendencies in the Soviet Union under the federative constitution, but this is only a seeming contradiction. By discarding the purely Russian local historical traditions the participation of the non-Russian elements in the Commonwealth has been facilitated, but on the other hand the disproportion, both numerically speaking and

in degree of culture, between the non-Russian and the Russian elements in the Union, is so great as to give an absolute predominance to the Russians in the Commonwealth. It must also be remembered that all the nationalities along the western frontier which have had a sufficiently marked culture of their own to keep themselves from being absorbed, such as the Poles or the Finns, have already detached themselves from Russia. The reconstruction of Russia on a federative basis would have been dangerous if Russia, like the former Austro-Hungarian Empire or like Byzantium, was a country where the national minorities were as important or more important than the ruling race ; that this is not the case may be judged by the following figures : the Russians and Ukrainians form 74·1 per cent. of the population (Russians 52·9 and Ukrainians 21·2), whereas the largest alien races are the Finns, 3·3 per cent., and Tartars, 2 per cent. The other races are represented in even smaller percentages.

We have examined the various constituent elements of Russia as a factor in civilisation, and we may now attempt to set forth clearly in what way her influence is felt throughout the world. First we must make a distinction between influences of a temporary and those of a permanent nature. The revolutionary activities of the Soviet Government belong to the first category, for its effects will only assume a permanent character if the world revolution becomes a reality, and in this even the Soviet leaders themselves are beginning to doubt, though they are still clinging desperately to this hope. But below the Soviet Government, and obscured by it, lies Russia itself with vast potentialities of action which are difficult to discern. These are of a permanent nature and are tending to increase, though they are ever changing in accordance with the nature of the modifications in Russia herself.

Russia will always possess a vast and fruitful field of action in Asia, and Russian influence in Asiatic countries may at times undergo an eclipse, but on the whole it is on the upgrade, especially since the whole continent has definitely been awakened to the importance of benefiting from the material aspects of European civilisation. For Asia Russia represents a channel through which this civilisation flows in a more palatable and diluted form than when it is introduced directly from the West. There are two reasons for this : first, the intermediate position of Russia allows the Asiatics to feel more at home there than in the West, and second, the exportation of European culture from Russia proceeds in two stages—it

first affects the native elements living on the territory of Asiatic Russia, who, after having digested it, convey it to their brethren across the Russian border into Asia.

If we turn to Europe we see that apart from the important reactions provoked by Russian activities in Asia or Eastern Europe, the West is interested in Russia inasmuch as the latter contributes to civilisation by her cultural achievements and to the general welfare of humanity by her economic development. In this respect we have to be at the same time hopeful and pessimistic; we may be hopeful in so far as the future development of Russia is concerned because the enormous potential wealth of the country has been only barely touched. On the other hand, what Russia has produced in the realms of science, art, and thought in the nineteenth century has been sufficient to give her a place in the history of civilisation which cannot be overlooked. Here also the national resources have merely been touched, for it must be remembered that with a few exceptions her total literary, scientific, and artistic output has been the work of one small class, the gentry, not much exceeding a million, which at the same time bore the burden of state-craft and state-building. It was only in the later half of the nineteenth century that this small cultural army was enlarged by recruits from other social classes to become what is now known as the "Intelligentsia," and still was a very small minority compared to the nation as a whole. Where in the democratic West every talent was given full possibility to bloom, that nothing might be wasted in the creative work of the nations, in Russia there is still a vast reserve of over a hundred million peasants, the energies of whom have not yet been drawn upon. In this respect the Revolution has been like shaking up a bottle of mixtures; we must await the rise through education of the lower strata of the nation in order to judge the creative genius of the Russian people as a whole and the full measure of their contribution to culture.

Considering the ingenuity of the Russian peasant the share of this contribution must vastly increase with the democratisation of culture in Russia. The German philosopher Count Keyserling says in his *Europe*: "I am certain of a great future for Russia, nay, of one of the very greatest in every respect. Within this marvellously gifted people, rich in soul and vital power, one of the most important cultures of mankind will blossom forth. But that great, radiant future which I foresee can dawn only after centuries. Until that time chaos is inevitable."

Without sharing too completely both his enthusiasm and pessimism, one must acknowledge that Count Keyserling has rightly pointed out the potentialities of the nation as well as the permanent danger of rampant chaos. There is a vagueness in the Russian soul akin to the shifting vastness of the national landscape which dissolves all too clearly cut issues. This process of dissolution is undoubtedly taking place with the imported Western culture now that it is no longer the exclusive domain of a small aristocratic minority raised on Western ideals. Thus the democratisation of culture in Russia means also its de-Europeanisation, inasmuch as the European culture can no longer be transposed without modifications, but has to undergo a deep process of adaptation to the requirements of a majority which has no background of European education. This for Russia means the end of an artificial situation which in a great measure was responsible for the Revolution : that of an eclectic minority so subservient to an imported culture as to appear alien in the eyes of the majority. But it also means that the lack of synchronisation between Western Europe and Russia will increase rather than decrease as time goes on. In the light of present events the recipe with which the liberal opinion in pre-War Russia sought to cure all her ills appears far too simple : " Westernise Russia more completely and everything will right itself." Far too simple also is the contention of so many foreign writers who see to-day a return of Russia to Asia. Russia cannot return to a place from which she has never come. It was Asia who went to Russia and for a comparatively short historical period, which is a very different matter. Must we therefore consider as right the over-ambitious credo of a new school of Russian thought, the Europeasians, who claim that " Russia is a sixth continent, ' Eurasia,' a knot and a starting-point for a new world culture." This tendency to differentiate Russia from the rest of the world has always been very marked in Russia, and may perhaps be explained by the fact that Russians do not feel themselves entirely at home in Western Europe and still less at home in Asia. It would therefore appear that the only course for Russia is, metaphorically speaking, to go neither east nor west but to stay where Fate has placed her ; she will thus evolve her own destiny from the contradictions of her history and make an original contribution to the treasure of the world's civilisation.

"Representation" in Music

ERNEST NEWMAN

THE Editor of THE REALIST has turned me on to a fascinating but difficult problem—one that, as he says, in virtue of its dual relation to art and life comes well within that concept of scientific humanism that is the special province of this journal. He is apparently puzzled by the fact that while the other arts, and even literature, have latterly been tending more and more away from representationalism, music, which one would have thought to have been the most naturally inclined of all the arts towards pure pattern and abstraction from reality, is coquetting brazenly with the representational, one composer, indeed, having been so lost to all sense of shame as to have actually tried to portray a locomotive in music. My Editor wants to know if the past of music throws any light on its somewhat dubious present, and what I think will be the direction taken by music in the future. As to the latter, I hope I am too wary a bird to rush into prophecy. I know little about the music of the future, but I have taken some pains, for many years, to scrape an acquaintance with the music of the past; and the one sure conviction the study has left me with is this, that in connection with music the only thing you can be really sure of is that you can't be sure of anything. However, there may be something to say even on this matter before we reach the end of the present article.

We used at one time to discuss the question of representation in music as a minor part of the bigger question of programme music. In the present article I propose to ignore, for the most part, programme music on the extended scale and concentrate on purely representational music. And the mere fact that one can be doing that at all in 1929 is surely significant. The æsthetic of programme music has been heatedly debated for well over a hundred years without our having come to a general agreement upon it. This of itself indicates that as yet there is nothing that can be called a satisfactory æsthetic of music. So far is the "nature" of music from being understood that it has not yet been realised that, in all probability, music has not merely one nature but several natures. No doubt in some future century they will all be resolved by science into the one fundamental "nature," but the time for that is not

yet : at present we know too little about music (for it is an art in constant process of development, new technical means and new capabilities of expression in it making their appearance every fifty years or so), nor has the man yet been born who is capable of working out a truly comprehensive philosophy or æsthetic of music. The scientists and literary men who have attempted that kind of thing in the past have had far too little knowledge of music—in some cases, even, too little natural feeling for it—for them to have been able to accumulate a thousandth part of the material that would really have been necessary as a basis for their deductions ; while the musicians have mostly had little or no training in scientific method, and have been much too inclined to take their own particular temperament as the norm of musical feeling, and to generalise from the insufficient data afforded by their own limited æsthetic sensibility and their own limited capacity for experiencing, so to speak, experience. The opponents of programme music in the nineteenth century made the mistake of setting up against it what they called " pure " music, the inference being that as programme music was obviously a different kind of music it must obviously be impure—a suggestion sufficient of itself to damn it in the eyes of the Victorians, or of any later writer with the Victorian mentality. It was felt that programme music was very much like a girl who had had a " lapse." It was true that a good many people found this sort of music very attractive, but they were probably the musical equivalent of the reprobates who would find that sort of girl attractive : indeed, is it not one of the constant grievances of the moralist that comely naughtiness is often more attractive than homely virtue ? And if the champions of " pure " music prided themselves on anything it was on their æsthetic virtue. The controversy really had its origin and its *raison d'être* in the mid-nineteenth century opposition to Wagner and Liszt. People of a certain sober musical temperament quite honestly reacted against the turbulent emotional world revealed to them in the music of these composers. They wanted a banner to fight under in their crusade against what they regarded as a species of musical immorality ; so they went back to the past, remade Bach and Beethoven in their own image, deduced from these composers—or from as much as they understood of these composers —an æsthetic of their own, discovered, or imagined they had discovered, the essence and the laws of " pure " music, and then

complacently proceeded to stigmatise the other sort of music as impure.

So far was the problem of the programme in music from being settled by the controversies of the nineteenth and early twentieth centuries that here we are in the year 1929 again discussing, as a contemporary subject of prime importance, not the broad question of programme music as a whole but the much narrower question of representationalism pure and simple in music. For no one contends that the representation of the locomotive in Honegger's " Pacific 231 " is programme music in the older sense of the term. It is not even necessary, for our present purpose, to commit ourselves to a declaration that it is music at all, in the hitherto current acceptation of the word. (But may not the word " music " some day come to include more than it has done in the past ?) The point is that whether " Pacific 231 " is good music or bad music, or not music at all, it is first-rate representation in sound. It is this fact, and what it connotes, that I had in mind when I said, a paragraph or two back, that it is significant that we should actually have this question to debate once more in 1929. For evidently there are composers in our midst who refuse to be impressed by the arguments of the devotees of " pure " music ; they feel like indulging in representationalism, and they are not going to be deterred by an æsthetic which, valid as it may be for one kind of music, does not, in their opinion, cover the whole field of the art.

For the plain fact has to be faced that ever since music became music there has been the cult of the representational : about the earliest case an account of which has come down to us is that of Timosthenes, the commander of the fleet of the second Ptolemy, who, as Strabo narrates, described in the musical idiom of his own day the contest of Apollo with Python. The programme of this lost masterpiece might well be that of a symphonic poem of the day before yesterday : there was a prelude, a painting of the fight, a triumphal strain suggesting the victory of the god, and a realistic representation of the hisses of the expiring monster in the syrinxes and pipes. (Our minds leap forward to the death shudder of Strauss's Don Juan, and the expiring sigh of his Don Quixote). The representational in music is evidently of remote ancestry. And the significance of this length of ancestry has surely been missed by the opponents of the representational. The other day I came across an essay,

dating from the eighteen-fifties, by the lively French critic, Scudo, in which, in the course of some telling general criticism of Berlioz, he fell foul of that composer for his passion for the pictorial in music. Scudo cites the old case of Timotheus of Miletus, who was condemned by the ephors of Sparta because in his setting of a poem dealing with the accouchement of Semele he had " imitated in an indecent manner the cries of a woman suffering the torments of childbirth." So you see, says Scudo triumphantly, that M. Berlioz was outdistanced long ago. I would humbly suggest that the instance he cites is capable of quite another interpretation. It seems to me that the mere fact that, ever since music began to be music down to yesterday, composers have persisted in trying their hand at representation, is a sign that the instinct towards the representational is rooted in the very depths of the musical consciousness. Call it a mistaken instinct if you will, an unworthy and deplorable instinct if you like, but there it is, and it plainly has to be reckoned with. On a rough estimate, I should say that ninety per cent. of the leading composers have at some point or other in their work made an excursion into the representational. Some have made it a cardinal feature of their work, consciously exploiting the possibilities of it. Others have merely indulged in it in passing. But hardly a great composer is free of it in some form or other. One of the few real achievements of contemporary musical æsthetic, indeed, is the demonstration that some composers, such as Bach and Schubert, seize with avidity on the slightest pretext to become representational, while others, such as Brahms, virtually ignore such opportunities. We have long been familiar with the division of men of letters into " auditifs " and " visuels." When our analysis of musical psychology is a little more complete we shall discover that a corresponding distinction runs through the mentality of composers. Moreover, there has been infinitely more representation in music than the public or the critics suspect. Thanks largely to the polemic in the name of " pure " music and the not unnatural reluctance to be associated in the public mind with anything that may be suspected of musical immorality, composers have mostly been afraid to confess the extent to which the representational enters into what is on the face of it " absolute " music. I myself have been the recipient of confidences in this respect that I cannot divulge ; were I to do so the reader would be astonished at the purely representa-

tional nature of certain passages in modern music that seem, to the uninitiated, symphonic music pure and simple. It is a fair inference that composers generally have, in the course of apparently non-representational music, indulged in representation to a much greater extent than the world imagines.

Without further labouring of the point, it will have to be conceded, I think, on the mere historical facts, that the impulse to representation is ingrained in musical humanity, or at all events in a very large proportion of it. That of itself, of course, may mean little; it may be that, like other impulses, this is one that humanity would be better without—a sort of original sin of which the good musical man will try to purge himself and others. Before we commit ourselves to that opinion, however, let us look at another aspect of the matter.

The opponents of the representational in music point with glee to the absurdities that have been committed in this department. It is quite true that many of the older specimens of musical realism now look comically old-fashioned—those in Kuhnau's Biblical Sonatas, for example. But are we warranted in assuming from this that the method itself is a fundamentally bad and futile one? That would be a dangerous line to take. The earlier specimens of programme music and realistic music look no more old-fashioned now, surely, than the earlier specimens of instrumental music generally. There have to be beginnings in all things. To this it will be rejoined that non-representational music has developed enormously through the last three centuries; and I shall be asked to point to any development in representational music comparable to that from, say, the more primitive pieces of the Fitzwilliam Virginal Book to the Eroica, the fourth symphony of Brahms, or the Chopin Ballades. But may not the answer to that be that representational music has not yet had either the time or the technical means to develop to the same extent? It is more dependent than non-representative music is upon developments that are strictly speaking outside the musical consciousness *per se*—the invention of new instruments and instrumental colours, for instance, and the acquiring of technical command over these. We can no more blame primitive composers for not having successfully translated the external universe into sound before the orchestral possibilities for such translation existed than we can blame primitive peoples for not having mastered the expression of abstractions before a language existed in which

the expression of the abstract was possible. Not only is the harmonic vocabulary of music in a state of constant development but new instruments supply the art with new colours, while every fresh stage in the mastery of an existing instrument may almost be said to make yet another new instrument of it. A thousand cases might be cited of a failure in the representational in one age being turned into a success in another merely by the later composer having a colour-instrument at his service that was lacking to his predecessor. There is a world of difference between Kuhnau's attempt to describe the flight of David's stone in the direction of Goliath's head by means of a little run of about an octave on the harpsichord and the representation of the flight of Klingsor's spear in the direction of Parsifal by means of a long harp glissando against a background of a violin tremolo and rich chords in the brass. No one who has not made a special study of Wagner's orchestration from the standpoint of the representational has any idea of the skill with which he conveys to us in tone the aural equivalent of an effect that is primarily visual. Most people have no doubt felt vaguely, in the forging-song in " Siegfried," that the orchestra was almost literally belching heat ; but how many have observed the subtle gradations of colour and of atmosphere in the brief orchestral passage that describes, while the curtain remains down between the second and the third scene of the opera, Siegfried's ascent to Brynhilde's rock ? We are conscious of first of all the fierce heat and the red glow of the outer bastion of fire through which the hero is making his way, then of a transition to a less fiery and murky zone, and finally of a cooler air and a clear light as Siegfried leaves the fire behind him and attains the summit of the rock. This is only one illustration of the marvellous pictorial faculty of Wagner, a faculty to which imperfect justice has yet been done by the critics. Not a single one of these strokes of genius would have been possible even to a super-Wagner of two hundred years ago, for the simple reason that at that time there existed neither the orchestra with which to realise it nor that unconscious dyeing of a composer's imagination in orchestral colour that has been the peculiar product of the evolution of the last century or so.

I fancy we must beware, then, of supposing that the feeblenesses and absurdities of so much of the representational music of the past are necessarily inherent in the genre itself. They are the result only of composers prematurely

attempting something for which there as yet existed neither the apparatus nor the technique. Nor need we, at this time of day, pay any attention to the old-fashioned musical æsthetic that based itself so precariously on Beethoven's famous "Mehr Empfindung als Malerei," *à propos* of the nature-painting in the Pastoral Symphony. It was characteristic of that school of æsthetic to play fast and loose even with the recorded declarations of Beethoven, clutching them to its heart when it thought they could be pressed into its own service, and blandly throwing them aside when the tenor of them was unfavourable to its own theories. As recent commentators like Bekker and Rolland have insisted, nothing can be clearer, from Beethoven's own words, than that his musical imagination was often swayed by suggestions from the outside world or from literature. The æstheticians have tried to pooh-pooh his own hints to this effect, because at all costs Beethoven must be pressed into the service of their own theory that the "true" musician writes only "pure" music. For the same reason they have read far more into his "Mehr Empfindung als Malerei" than, in view of the facts of the symphony itself, the words can possibly bear, for there is a great deal in the Pastoral that is decidedly more Malerei than Empfindung. But the case for or against representational music does not depend in the slightest degree on Beethoven's æsthetic, or on his success or failure with the genre. His experiments are interesting as showing that he too, like so many other composers, was now and then tempted to try to translate the external universe into sound, and that by way of realism rather than by way of sentiment; but the case for representationalism is as independent of his efforts as it is of those of Byrd or Kuhnau. The only thing that matters, the only test that is really valid, is whether the thing can be done or not. Ten thousand episodes in the music of the past century prove that it can; and now comes Honegger to show that, with the modern orchestra and a modern technique, even so apparently non-musical a thing as a locomotive can be translated into tone with an astounding fidelity of realism.

Is there any reason to suppose that the process and the development are going to end with the "Pacific 231"? Why should they? Is it not much more probable that that curious work is only a beginning? As the technique of the modern orchestra develops, and as composers win more and more mastery over that part of their imagination that is directed

outwards to the world of reality, why should not we have, in music, examples of the representational that will make the "Pacific 231" seem as primitive as the Battle Capriccio of Frohberger or Kuhnau's "Fight between David and Goliath" does now? What man will be bold enough, in the light of the tremendous evolution of the last four hundred years, to set bounds on any side to the possibilities of music? And who that knows how pitifully the current æsthetic has failed to throw much more than a feeble glimmer of light on the nature of music will dare or desire to dictate to the composer what he shall and shall not do with the material the centuries have placed at his disposal? Music, we may depend upon it, will work out its destiny regardless of our theories or our prejudices; and composers who are driven along by something that is stronger within them than theory will in the future, as in the past, do what they feel like doing, let the æstheticians, who are always a generation behind the times, say what they will. Honegger has told us that from his childhood he has had a passion for locomotives; they have been to him what women or horses are to other men. That being so, why should he not be as free to express in orchestral tone the delight with which a locomotive fills him as other composers are to pour out the ecstasy with which a woman or a heroic action fills them?

It may be replied that it will be a sorry day for music when composers turn away from humanity and devote their talents to the delineation of purely external and non-sentient things. But in the first place there will be no danger of composers in general doing so, for not all composers are built that way; and in the second place, if a composer *is* built that way, nothing will stop him from expressing himself in that way, and if the thing is done well the sensible thing for the rest of us to do is not to curse him in the name of a past æsthetic but to enlarge our own conception of æsthetic.

My own complaint against the "Pacific 231" is not that some of it is representational but that it is not entirely representational. I find the descriptive portions fascinating; the less satisfactory portions are those in which Honegger writes music of the ordinary type along the ordinary lines. He should not have tried to accommodate the two genres; he should have had the courage of his convictions and his technique and made the whole composition purely and simply representational. An evolution of music along these lines cannot be ruled out as being

beyond the bounds of probability; the desire is obviously there, the means for realising it are coming into being, and if composers with a gift for that kind of thing like to cultivate their gift it would be an arrogant impertinence on our part to try to restrain them. We must keep in mind the cardinal facts on which I have been insisting in this article—that music is an art that is always evolving, because new methods are always being hit upon, new instruments being invented, and a new command won over the old instruments; that no one has the right to say that this or that way of writing music is contrary to the true nature of the art, for there is as yet nothing approaching an authoritative æsthetic of music; and that anyhow composers will do what they like in the future as they have done in the past, obeying deep-seated unconscious impulses and leaving it to the theorists to accommodate their theories to the new results if they can. A theoretician of the Palestrina epoch would have laughed to scorn the notion that music could suggest to the ear something of the same heat and the same dull red glow as a forge suggests to the eye; yet Wagner showed that the thing could be done. Wagner himself, while agreeing that music could suggest the bulk, the brutishness, and the lumbering movements of a dragon, would have been sceptical of music being able to suggest a locomotive getting up steam, grinding on the rails, and slowly working up to the mighty symbol of speed and power that a train in full flight is; yet Honegger has shown that the thing can be done. Who will have the temerity to say that the evolution of something like two thousand years has ended with Honegger and his locomotive?

The reader must not run away with the notion that I am suggesting that this is to be *the* music of the future. There will be no one music of the future; there will simply be music of this kind and that kind, only there will be more kinds in the future than there have been in the past, and a highly developed representational music may be one of them. And so far as it is good music of its kind it will attract; if it comes from a genuine artistic impulse on the part of the composer it will satisfy a genuine artistic need in the listener. But true representational music will probably be what the "Pacific 231" should have been but is not; that is to say, frankly representational throughout. The old attempts to blend the representational and the sentimental, the painting of a scene with man's emotional reactions to the scene, as in Beethoven's

Pastoral Symphony, may conceivably be abandoned in favour of realism pure and simple. And it may well be that along this line one desire that is characteristic of certain artists of our generation—to construct interesting edifices of sound without any resort to sentiment—may at last find its true outlet. Music, in one part of its being, is a sort of moving architecture: why should it not learn to convey to the ear something of the same non-human, non-sentimental fascination of pure line and mass as we get, for instance, in the stark lines of scaffolding thrown up against a background of sky?

In their revolt against music with sentimental implications some of our modern composers have flopped over into absurdity. They want to write, as they tell us, music that is simply "music," without any dependence upon suggestions from literature. Their æsthetic is not wholly sound, but there is something in it. They merely go about trying to realise their ideal in the wrong way. Stravinsky, we are told, "sees no reason why an impression that is already conveyed by one art should be merely duplicated by another. A fine poem, to him, gains nothing by being set to music, and this explains how, in his later songs, he came to choose words which in themselves possess no beauty and very little sense. The 'Pribaoutki,' the 'Berceuses du chat,' the '4 Chants russes,' and the '3 Histoires pour enfants' are all written to childish or simple popular texts of no literary significance." Other composers have tried to convey to us their contempt for the ordinary song, in which the music, according to them, merely attempts to do over again what has already been done well enough by the poetry, by setting words that are frankly meaningless or grotesque; one of them has set a page from a florist's catalogue, another a series of press clippings. These good people are the victims of a double delusion. In the first place they imply that their great predecessors of the song were all fools, for if what they took such trouble to do was æsthetically preposterous, only congenital idiots could have made the mistake on so colossal a scale and persisted in it so long. Further, they imply that all the rest of the world, in admiring these songs, were fools who did not understand the true nature of music. With all respect to these mighty intelligences, we cannot accept either their flattering description of themselves or their unflattering description of the great song-writers and of us; we really cannot see any good reason why, because they

are so very virtuous, the rest of us should deny ourselves cakes and ale that agree with us.

But apart from that, they make the cardinal mistake of still writing in a vocal and a lyric form without the justification for such a form that originally came from the association with words and depends for its very life on words. The result is that they do not, as they imagine, escape the bonds of sentiment in music, but merely write music that is sentimental without good reason, and feebly and irrelevantly sentimental at that: as Mr. Colles has put it, following on the quotation of the passage concerning Stravinsky that I have cited above, this explains "why a man of undeniable genius," as Stravinsky is, "has fallen into writing music which possesses no beauty and very little sense."

With the desire of these people to achieve a music that shall be free of the facile emotionalism transmitted to us from the romantic past we can have every sympathy; it is not that we believe that the days of emotion and Romanticism in music are over—the next great man will make short work of that nonsensical theory—but simply that there do happen to be other views of the universe than the romantic, and art is, or should be, broad enough to accommodate them all. As I have tried to show, a genre of non-emotional, purely representational music is quite within the bounds of possibility, and if the thing can be done, and done well, it will soon justify itself in the ears of everyone who is not so foolish as to think that, of all the ways of apprehending and expressing this infinite universe, none can ever be open to music but those discovered by the art in what is assuredly only its infancy. May not the way of escape from the romantic, from the eternal repetition of the same eternal half-dozen formulæ of emotional expression in music, lie in the direction, not of an ostentatious jeering at and flouting of the poetic, but of a resort to the musical representation of aspects of the universe that have no more human or poetic or sentimental connotations than the lines of scaffolding against the sky, or the grind and sweep of a locomotive getting under way?

Colour Music

VERNON J. CLANCEY

ABOUT five years ago—July 1924—there appeared in the "Callisthenes" column of *The Times* an announcement that a Mr. Lewis Barnes would demonstrate at a famous Oxford Street store the idea of "adding to the beauty of music the glory and richness of colour, that the welding together of these two exquisite arts will bring forth something that is even more beautiful and artistically complete." The statement went on in panegyrics that "music in colour will naturally open a wide field of thought, because it embraces an idea that surely must appeal to every lover of the beautiful in art and music." Mr. Barnes's pianoforte recital of music accompanied with a background of slowly changing coloured light was the first that this generation had seen of a long-established ideal.

The Greeks[1] played with analogies between colour and sound, they appreciated the general resemblances between the ocular and auricular sensations; but beyond drawing these broad analogies they did not theorise on the psychological effects of ocular presentations. Giotto, the Byzantines, and the early Venetians, idealising the gleam of gold and the splendour of colour, in subjects in which they were free of restraint, laid the foundations of a colour theory; but, delayed, perhaps, by the advent of the realists, the portraitists, who delighted in detail of utensils, costumes, and buildings, it was not until the sixteenth century that any definite formula was determined. Such formulæ were bound to appear, the physical and psychological aspects of sight and hearing being so apparently similar; but hitherto the issues had been confused by their reluctance of dissociating the effect of the abstract from the objective associations.

Almost simultaneously, Archimboldo, the Milanese painter, and Kircher brought forward the theory that everything which can be made visible to the eyes can be made audible to the ears and vice versa. This totally erroneous idea was the basis of a

[1] "Τὴν μὲν ζωγραφίαν ποίησιν σιωπῶσαν (προσαγορεύει) τὴν δὲ ποίησιν ζωγραφίαν λαλοῦσαν."

SIMONIDES, *Plutarch.*

multitude of experiments and theories, of an extraordinarily arbitrary nature, into the relations between colour and sounds. Its direct outcome was the publication, in 1720, of a theory of music in colour by Louis Castel, a French Jesuit of considerable scientific standing. He found in Kircher's work the theory that " if we could see the agitation of the air during a concert, we should see it strewn with all the most vivid and harmonious colours." This led him to the statement of the possibility of composing music in colour, " . . . why not make ocular clavessins instead of auricular ? " Ultimately, in 1734, he built an " ocular clavessin " on which to play colour music ; but the results seem to have been very unsatisfactory and to have discouraged him from further work on these lines.

There followed a period of very unscientific research into the subject—for example, D. Jameson, of London, and others attempted to translate simple melody into a visual form by the use of opaque or transparent coloured bands and various mechanical devices. The basis of these attempts appears to have been the transposition of musical notes into a colour scale obtained by an arbitrary division of the spectrum band, or even less rational analogies—one worker claiming to interpret human speech in colour.

The advent of the projection lantern, the convenience of electricity, together with the engineering and art training of Professor A. W. Rimington, were responsible for a new era in colour-music theory and practice. In 1893 Rimington demonstrated, in Norwood, a " colour organ " invented by himself, with the assistance of a musician friend, Mr. De Vere Barrow. Subsequent concerts at the old St. James's Hall and in the provinces aroused considerable attention ; but the press appears to have misunderstood the objects of his music and in 1895 he ceased his public performances.

Professor Rimington's work, based on a certain scientific knowledge of wave-length considerations, was followed up by the development of the Barnes instrument, and independently by an American-Danish singer, Thomas Wilfred. The latter invented a " Clavilux," which he demonstrated in New York on January 10, 1922. A tour of the States followed, and in 1925 Wilfred, with a new improved clavilux, gave a recital tour in Europe, including two concerts at the Queen's Hall, London. *The Times* of May 18 noticed these recitals at some length :

"The 'Clavilux' is a keyed instrument by means of which the colour, form and movements of light thrown on to a white screen can be controlled by the operator. Mr. Wilfred claims to have added a new and independent art to the accepted hierarchy of music, poetry, painting and sculpture. He calls this the art of light; but it would perhaps be more accurately described as the art of mobile colour.

"The forms moved up or down the screen, sometimes with a revolving motion, but never across, the only lateral movement was expansion. The colours used and blended are red, green and blue. Of these, only the blue was really pure and intense and it would seem necessary to add amber, . . . in order to obtain good yellows, which were noticeably absent. The movement consisted mainly of an even progress over the surface of the screen, and the general effect may be likened to that of a cloud produced by the latest contrivances for realistic lighting in the theatre."

It is interesting to note that this recital immediately followed the Scriabin Memorial Concert. Scriabin was the first composer of note to employ colour in conjunction with music, his score of the "Prometheus" symphonic poem containing a part for the colour organ. This was performed for the first time with light in New York—the apparatus having broken down at the previous performance in Moscow—by the Russian Symphony Society, in 1915. It met with a very cold reception by the critics, who failed to find any relationship between the sounds and the colours projected on the screen.

"So far as the lights were concerned, it could not be discovered how they added to or intensified the meaning of the music. They were continually shifting and melting, but without visible relation to the sounds. In the midst of what seemed to be one phrase the lights would change half a dozen times. There was no variation in the intensity as the music grew more emphatic; at the height of its proclamation there was the same pleasing variety of yellows, oranges, violets, purples and emeralds as there was in the beginning. The composer's clue was not entrusted to the lights, and to the first bewildered beneficiaries of the new art it seemed still to be a sealed book."

Despite the adverse reception both by the press and the public of these performances, a large number of enthusiasts continue to work along this line of constructive theory. These workers have started from the physical transposition theory of Rimington, the basis of the transcription being the literal application of musical theory to a scale deduced from a consideration of relative frequencies of vibrations.

Music, in its natural evolution, developed a system of scales based on an aural consideration of harmonics—resulting finally in the modern diatonic scale, a combination of the natural intervals and certain mathematical intervals as compromises introduced to reduce the necessary number of notes in the octave consistent with the ability of playing a seven-tone scale with any note as the key-note. This system of " equal temperament " requires twelve equidistant semitones—the distinction between F sharp and G flat, C sharp and D flat, et cetera, disappearing—of which the frequencies and ratios are thus :

Notes	C B♯	C♯ D♭	D	D♯ E♭	E F♭	F E♯	F♯ G♭	G	G♯ A♭	A	A♯ B♭	B	C′ B♯
Freq.	256	273	288	307	320	341	352	384	410	427	448	480	512
Ratio to C	1:1	15:16	8:9	5:6	4:5	3:4	8:11	2:3	5:8	3:5	4:7	8:15	1:2

It is by a direct translation of these ratios to the frequencies, or inversely the wave-lengths, of the colour bands that the theoretical colour scale is obtained.

The visible spectrum extends from a wave-length of 0·7595μ (μ = 0·001 millimetre) to 0·3968μ, or a range of slightly less than one octave. If now we consider a line just within the red area of wave-length say 0·7360μ—convenient for division by the ratios—as the key-note of the scale we get :

Note.	*Ratio to key-note.*	*Wave-length in μ.*	*Colour.*
C	1 : 1	0·7360	Dark red.
C♯	15 : 16	0·6900	Red.
D	8 : 9	0·6528	Red-orange.
D♯	5 : 6	0·6130	Orange.
E	4 : 5	0·5890	Yellow.
F	3 : 4	0·5520	Yellow-green.
F♯	8 : 11	0·5352	Green.
G	2 : 3	0·4906	Blue-green.
G♯	5 : 8	0·4600	Blue.
A	3 : 5	0·4416	Blue-violet.
A♯	4 : 7	0·4204	Violet.
B	8 : 15	0·3920	Dark violet.
C′	1 : 2	0·3680	Invisible.

These are the particular wave-lengths adopted by Klein and some other experimentalists. It is evident that not only is the relationship between the music notes and the colours based on an arbitrary key-note, but also the colour scale is considerably altered if the key wave-length is altered. As represented in the above table, the fundamental key—that is, the key in which appear the total complement of pure colours, corresponds to the musical key of B (5 sharps), which is of quite different value from the basic key of C, since it includes the greatest number of approximated intervals—for example the frequency of the fifth is 352 instead of 360. At the same time a change of the basic wave-length will tend to lose some of the pure colours—for example, if red (0·6900μ) is taken, then the notes become red, orange-red, orange, yellow yellow-green, yellow-green, green-blue, green blue-green, blue, violet blue-violet, and so on.

In spite of its apparently scientific deduction the analogy cannot be carried any further. There is firstly a very considerable latitude of wave-length without appreciable colour change in the blue-violet region, while a small change is apparent in the red-orange area ; secondly, it is extremely difficult to adjudge the consonance or dissonance of colours ; and thirdly, any harmonics which a colour may possess are of necessity outside the visible range.

However, experiment has shown that such a scale is broadly comparable to the musical scale, particularly if we accept the Rumford theory of harmonious colours—that is, the harmonious nature of complementary colours. In practice, higher and lower scales are added by desaturating, diluting with white or grey light ; but it is impossible to advance very far along this line of thought, while the idea of transposing direct from music to light seems very unsatisfactory. There is, however, no doubt that this is the logical derivation of a colour keyboard, and must be the basis of further lines of work.

The other trend of thought in colour-music theory finds its origin in the real or assumed psychological values of the different colours. Numerous experiments have been made, by Luckiesh, N. A. Wells, and others, on individual reactions to colours ; on the average associations of colours and sensations. These researches, together with the work of Bullough on *The Aesthetic Appreciation of Single Colours*, and Dr. C. S. Myers', H. J. Watt's and others' work on the psychology of perception, have led to various enunciations of colour-music theories.

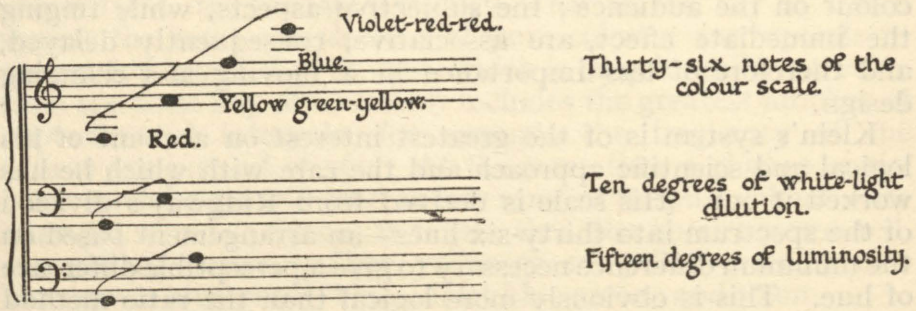
Bullough and Myers' *Perceptive Types* (abbreviated in Table I), are the accepted basis from which the majority of theorists, including Klein, have worked. Of these four aspects, the most important to colour music are the Objective and the Physical, since they are the immediate effects of abstract colour on the audience; the subjective aspects, while tinging the immediate effect, are associative, consequently delayed, and therefore of less importance in a moving and changing design.

Klein's system is of the greatest interest on account of his logical and scientific approach and the care with which he has worked it out. His scale is derived from Ridgway's division of the spectrum into thirty-six hues—an arrangement based on the minimum difference necessary to give a perceptible difference of hue. This is obviously more logical than the ratio method derived from harmonics, provided that the idiom and rules of music are not adhered to to the extent of adopting its system of harmony and melody. He further considers the relative luminosity of the spectrum at its different parts, the persistence of vision and its effect on the subsequent colour, and even includes the consideration of the after-image—that is, the image of complementary colour seen after a prolonged impression of one colour.

TABLE I. AN ABBREVIATION OF BULLOUGH AND MYERS' PERCEPTIVE VALUES.

Colour.	*Objective Aspect.*	*Physical Aspect.*	*Association Aspect.*	*Character Aspect.*
Red	Bright, loud, vivid, projecting.	Hot, exciting, stimulating, glaring.	War, blood, Red Flag, trumpets, horns.	Threatening, brutal, revolutionary, martial, vulgar.
Orange .	Loud, bright, projecting.	Exciting, enlivening.	Sunset, autumn foliage, oranges.	Gay, energetic, cheerful.
Yellow. .	Extremely bright.	Cheering.	The East, citron, sulphur, daffodil.	Cheerful, jealous, treacherous.
Green. .	Uncertain.	Uncertain, soothing, cool.	Vegetation, sea, Ireland.	Peaceful, serious, thoughtful, calm.
Blue. .	Receding, quiet.	Cooling, restful, tranquillising.	Sky, ponds, mountains, distance, flute.	Spiritual, noble, tender, sad, pure, dainty.
Violet. .	Dark, receding, distant.	Warm, subduing.	Funerals, death, ceremonial, 'cello and bass.	Regal, dignified, mighty, solemn, serious, mystic.

The three variations on which he relies for his effects are changes of colour, light dilution, and luminosity, for which he requires an organ of forty-six manuals and fifteen pedals. His notation, then, includes three clefs to cover these changes, thus :



While this is apparently an ordinary music notation it is fundamentally different in that the melody is played entirely in the treble, the two bass clefs simply being the modulations, and that the notes bear no simple harmonic relationships. In the majority of previous notations the entire Colour scale was confined to the octave C to C^1, the higher and lower octaves on a keyboard of the piano type being reproductions of this scale less or more saturated and diluted.

Such an organ gives almost perfect control of the light ; but as yet there are no controls for the movement of the light patches nor for the playing of chords. For the ideal rendering of music in colour he postulates an elaborate arrangement of six projectors in a special hall, for which his requirements include :

1. An interior space devoid of decoration, perfectly smooth, dull white, and hemispherical or cylindrical in form.
2. At one end a sound orchestra, invisible as in Wagner's Bayreuth Theatre.
3. A projection box at the rear of the hall, in a turret placed half-way up the rear wall.
4. Six projectors to make six rectangular patches of light on the wall, exactly juxtaposed, each patch to be twenty feet high by twelve feet broad, variable down to a minimum of one foot.
5. The group of patches to fill the visual field of everybody in the hall.

With this arrangement, he visualises the perfect presentation of colour plus sound music. Simple melody in colour is played by a succession of single hues, harmony by juxtaposed hues and moving and variable-sized patches. This probably is the most ambitious and idealistic scheme which has been worked out; but, as Klein himself says, the cost of the installation, including the special building, would be £10,000 at the minimum, so that, for the present at least, it appears as if colour music of this calibre must remain the dream of a few enthusiasts and the subject of much controversy.

There is, however, another field into which these enthusiasts might penetrate and bring the results of their researches and inquiries—the modern cinema. The New Gallery, Regent Street, was probably the first picture house to install a system of variable house lighting, for the better entertainment of the patrons and the better to lure them through the turnstile. This American idea of playing with fading coloured lights during the musical interlude was further developed and incorporated in the designs of the Capitol, Plaza, and other West End houses, all in an effort to justify the luxurious plush and the prices. Necessity, in terms of dollars, calling for further elaboration, more purple and gold, brought into existence the "Atmospheric" theatre with an expenditure of thousands on lights, organs, and decorations as the new sprat.

This appeared to be the culmination of an effort to satisfy the recently realised desires of the public, the desire to have their pictures served up with the traditional flunkeys, frills, and garnishings of the legitimate theatre. Commercial ingenuity and imagination ran to landscapes and Spanish exteriors as fitting make-believes for the picture see-ers, all of which called for more elaboration of house lights to further the illusion. There was then no big drum talkie on which to bang, so they went back to the scenic railway and Hale's Tours.

The importance of this to the colour musician lies in the springing up of the new cinema, of which the Regal, Marble Arch, is the London prototype, cinemas in which are to be found all the latest stage, flood, and house lighting tricks and stunts waiting an intelligent use. At present "Sonny Boy" sobs out in dim blue, trumpets blare red, and the drums roll to the accompaniment of flashes on a darkened dome, while the conductor bows, spotted white, from a descending rostrum as the orchestra rapidly disappears from sight, lights fade out, the

picture is on. This, it seems, is what the public appreciates; managers are showmen, so the possibilities remain unexplored.

In these cinemas is to be found the closest approximation to Klein's requirements. The equipment at the Regal may be taken as typical of the most elaborate in this country. The house is wired with a four-colour system—blue, red, amber, and white—which can give all the scale and dilutions required by the Klein notation. Back-stage is the main control board, with interlocking switches, so that any combination may be handled by one master rheostat, one set fading out while another fades in and so on. This board controls the general house lights, the footlights and other stage batons, and certain special effects such as the " moonlight " behind the organ screen. Above the auditorium is the spot-light gallery, with a battery of spot and flood lights to cover the proscenium and the orchestra. In the projector room at the back of the theatre is a triple " effects " projector, of the type which floods the stage curtains, giving effects of snowstorms, clouds, and so on, and abstract moving patterns of light. If, then, the stage curtains were replaced by a flat screen or draped white or pale grey material, the hall lights would have to be kept of less intensity than the screen and used as an accompaniment, by comparatively slow changes in hue and dilution, while the " effects " projector, supplemented with floods and spots, plays the melody on the screen. Klein's notation might be used, the top clef referring to the hue projected, the second to the intensity of the white floods, and the third to the luminosity. It is necessary to add to this another clef for the house lights, having four notes for the colours—chords of two or more giving the intermediates—with crescendos and diminuendos marked with figures to indicate the intensities ; these changes would be slow and often held for many bars, so that the difficulty of manipulation would not be as great as might appear. It does not seem necessary to employ complex moving patterns of colours, except occasional mixes to give effects of chords, slurs, and so on.

A little thought will indicate many methods of achieving special results—such as the splashing of the screen with alternate black and colour, the changing of the colours from side to side, or base to top, and so on—for which some code must be worked out ; it seems, however, that it is in the cinema that the theories must be tried out. Recently I suggested that the Regal orchestra, under Mr. Starkey, might try the " Prometheus " with

colour effects as scored; but he pointed out that the musical interlude formed too small a part of the programme for which the public had paid. However, it would be perfectly feasible for an enthusiast to give a Sunday afternoon concert and so to test out the application of the combined physical and psychological theories of colour music, in a hall where not only is there adequate screen equipment, but the whole audience is immersed in the accompaniment. It is only by such experiment that the subject can be carried any farther than an amusing toy and aimless theorising.

Editorial

The Political Situation

THE more we reflect upon the General Election, as upon all General Elections in this country in recent years, the more unsatisfactory the whole situation appears to be. The leaders of the Labour Party will quite naturally exult at their success at the polls, for the number of seats won by the Party far exceeds their most optimistic expectations. Mr. Baldwin and his followers have every reason also to be more than satisfied with the number of seats they have retained. The leaders of both Parties are congratulating themselves upon the failure of the attempt of the Liberal Party to regain its former political ascendancy, a failure which they interpret, in spite of the fact that the Liberal Party candidates polled over twenty per cent. of the total votes given, as a desire on the part of the country to return to the two-party system. Possibly the Liberal Parliamentarians may facilitate this return. They themselves, conscious of their abilities and anxious to put these at the disposal of the country, may transfer their allegiance to one or other of the two stronger Parties. The Radicals among them may feel like Sir William Jowitt that the Labour Party programme fits in adequately with their political ideals. The Liberal Imperialists, on the other hand, may feel that everything is to be gained by associating themselves with the Conservatives. Whether this will satisfy the Liberals among the electorate we have no present means of ascertaining. One thing is certain, that if there is this division and separate attachment of the Parliamentarians in the Liberal Party, there is very little hope of electoral reform within the next decade or so : in other words, the country will be condemned to machine-made policies. Minority opinion will be disregarded and every reform will have to be made popular. Progress will be dreadfully slow. Old men will continue to dominate the political situation. Functional representation will be as far off as ever. Members of Parliament will continue to grumble at the delays due to the intricacies of Parliamentary procedure. Some small reforms may be effected, but the leaders of no party are likely to display any eagerness for limiting the powers of the Cabinet or even for the abolition or reform of the Second Chamber. Similarly, most reforms, for the understanding of which few politicians possess the necessary equipment of knowledge, will continue to be remitted to Royal or special Commissions and made the subject of voluminous reports, but action delayed upon any recommendations they may contain.

When men talk of the failure of democracy, they mean the failure of the democratic machine to express the feeling of the electorate. Apathy is a late development in politics. Men turn away because they no longer believe they can get their wishes expressed. The vast masses give up trying. The energetic minorities conspire. This is a political soil which has allowed the dictatorships of Southern Europe to spring up. It is for the Party now in power to ask whether it wishes to prevent this development. The next few months will show whether the people's Party really cares for representing the people or whether it too, as all the political parties before it, cares for power at any price. The Labour Party is not constituted for any rôle save a constitutional one. It would be wise in its days of power to trust the people

and strengthen the constitutional machinery. Mr. MacDonald will be wise if he does not take the results at the polls as more than an indication that the majority of those who helped to return his candidates to Parliament were dissatisfied with the previous government. Primarily they expect from him the material benefits which they failed to obtain from his predecessor. If these are not forthcoming, and quickly forthcoming, they will turn from him. They will judge him by the success of his efforts to deal with unemployment, not by any increases which may be made in unemployment benefits, but by the diminution in the number of unemployed : not by his friendly gestures to other countries, but by the effect which his foreign policy has upon the export trade of this country. For the most part he has gathered round him Ministers whom the country regards as competent to discharge the very heavy responsibilities which devolve upon them. They give the outward appearance of being animated by the team spirit. The team has a wonderful opportunity, for the country, if we read the portents aright, has every intention of giving it a fair trial. The country wants its most urgent problems solved, and it realises that they cannot be solved in a few days.

Denmark and Disarmament

INVOLVED in the domestic issue of our own elections we can hardly be expected to pay much attention to those of other countries. Yet there is one that may mark a new phase in European history and about which therefore we would do well to advise ourselves. The Danish elections led to the return to power of the Labour Party, which in a previous term had brought in a Bill for disarming the country and which has won its way back into power with this issue in the forefront of its programme. We do not, as a nation, underrate the importance of disarmament, but we are apt to argue that advance depends on the League and that the League can't advance until its members are in step. Meanwhile everyone is waiting for someone to take a first step. We are all encouraged by America's attempt to devise a plan whereby we could all step down together, but no one knows how long that adding of simultaneity to parity might take. And now Denmark has declared its intention of waiting no longer, but of stepping out on its own. Is not this the event on which all have been supposed to be waiting? Yet not only has it been belittled, it has been received by many with positive dismay. Not least the military, for it was on their evidence that the Danish Government is acting. They showed—in the popular manner they have learnt as the new weapon, propaganda—that the Sound could be blocked, Copenhagen bombed, that the nation was defenceless. They offered the usual dilemma, surrender to them or to the enemy, and Denmark, bringing her Hamlet up to date, has decided better to fly the ills we have than endure others that we know not of.

The decision is one, no doubt, of supreme international importance. The country has only a population of four millions, but her position geographically, and even more culturally, gives her an influence which bears no relation to her size. Increasingly in social questions, what Denmark thinks to-day Europe thinks to-morrow. The argument they are now advancing is realist rather than idealist. In the world of scientific warfare can Denmark be

defended? The answer is, no. And a realistic people act on their conclusions. It is only muddle-headedness to attempt at the same time two mutually exclusive policies. If defence is helpless before air attack, why continue to talk of defence? If the League exists, why carry on armament races? Such confused behaviour in the present paranoic state of Europe is precisely the way to provoke attack. If you want to avoid war avoid the appearance of threatening war. This is to be Denmark's line. She will trust a civilisation whose constituents swear that they never attack others. She will take Europe at its word. Is it such a gamble? Need we by shaking our heads denigrate our characters? Even the Red Indians respected the covenant Penn made with them. Modern armaments are not necessary to the wealth of modern nations, or Germany would never have recovered as she has. As for that sleeping safely in bed, which is the militarists' other argument, who will say that Denmark is any less safe than the rest of us? Meanwhile she will enjoy the higher standard of life which complete freedom from armaments bills permits, and the higher moral position which belongs to the first nation to give proof of pacific good faith.

The B.B.C.

OF all the national concerns of to-day Broadcasting has perhaps the most interesting possibilities of development in the future. It was for this reason that there was almost universal approval when it was decided that its control should not be left to any private concern: it should be in the hands of a public corporation. Such a manner of carrying out a new enterprise is in keeping with the spirit of our time. The old general commodities are slowly being put under general control. *A fortiori*, the benefits and possibilities of a new power of widest commonalty should be administered by a new body. The idea commends itself because in the conduct of an original enterprise of national interest it is obviously necessary that a system should be devised which on the one hand will raise it above that dependence on immediate profit-making which is the fundamental limitation of capitalistic enterprise and on the other will free it from the ordered delay and minute-ruled inflexibility of bureaucratic administration.

Quite as much, then, because it is our first attempt at this new and hopeful way of nationalising as because of the subject's own possibilities, the present state of the B.B.C. is of national concern and one the reorganisation of which a democracy must take in hand. That reorganisation is needed there can be no doubt. A late assistant director of Programmes has just told the public that he had to resign " because there is in the B.B.C. an entire lack of decision. They are too confident, too distant, and too afraid to take a definite step . . . because an idea has to be pondered over, analysed, discussed in committees, and finally massacred, until there is only a ghost of an inspiration and the heart of enthusiasm has gone." This is bureaucracy drawn to its cold-blooded life. This may be the way to run a Church Assembly with " safe, central men," but it is not the way to give the British Public the service for which it pays amply. Even less can it lead to the B.B.C. itself having the chance to apply those further developments which the advance of radio science continually offers.

Yet pure Bureaucracy, though unsuited to conduct anything which can

be called an enterprise, has at least the qualities of its defects. The machine may be uninventive and inhuman, but at least it is not petty and personal. Of its nature it escapes the capricious despotism which is the ugliest feature of private enterprise. That some such arbitrary power is exercising itself in this national corporation no one who has watched the steadily swelling retiring list of B.B.C. officials can doubt.

In short this which should be a most interesting experiment in national social service, instead of giving us a new way of conducting our common interests, seems to have presented us with an anomalous body which manages to combine with unhappy balance exactly the disadvantages both of administrative routine and of private undertaking—the lack of enterprise of an ancient Department and the irresponsible authoritarianism which is often the prohibitive price of businesses of brilliant initiative.

Looking at the facts which have already come to light it is not possible to escape the conclusion that the success or failure of such a vital organisation as the B.B.C. (and such similar corporations as must undoubtedly follow) depends more than any other type of organisation on personality. For when there is neither the private inspection of shareholders looking for their profits, to test efficiency, nor public inspection (the expenditure of the B.B.C.'s huge tax-raised income is almost as mysterious as the secret service fund), a head is required peculiarly gifted not only with enterprise but with the power of encouraging it in others. If that head were simply a good business man or a good bureaucrat, that would not be enough. What is wanted is a new type of man. No doubt experiments had to be made. How they were made in this case the public has not been told. That will not, however, matter much if the Government recognises that they must continue. The country looks to a Government, which it has put in power because they offered to devise new organisations to administer the national concerns, and have said that they are not afraid to rid us of anchylosed administration, not to let this essential experiment in nationalisation break down because of internal maladjustment. If they do, reaction will seize upon a failure of personalities and charge them with a mistake of principle. For the sake of commending their general policy to the electorate they cannot afford this. The people are listening in and are not satisfied. A new ordering of Savoy Hill may well impress England as much as any initial act that the Government does not intend to let its principles be spoilt by ill practice.

Notes on Contributors

Dr. W. Kaempffert

Dr. W. Kaempffert, as the first Director of the Rosenwald Industrial Museum, has planned and is putting into practice that conception of a dynamic museum without which, as Mr. Nicholson showed in our last Number, the Museums are of little use.

Dr. S. Zuckerman

Dr. S. Zuckerman's post as anatomist to the Zoological Society of London has allowed him opportunity of studying Primate behaviour. He has also studied the subject under field conditions. This essay was first read in draft before the Anthropological Society of London University.

Prince A. Lobanov-Rostovsky

Prince A. Lobanov-Rostovsky stayed in Russia until 1920. Since then he has contributed to current reviews a number of studies on Russia, and its reactions both to Asiatic conditions and Revolutionary movements.

Dr. Harold Jeffreys

Dr. Harold Jeffreys is a Member of the Council of the Royal Meteorological Society, and his book *The Earth : its Origin, History, and Physical Constitution* was among the best summaries of present geological knowledge, to which his own researches have greatly contributed.

Mr. Ernest Newman

Mr. Ernest Newman began his career as a musical critic a quarter of a century ago. He is also the author of many books on music, especially on the biographies of musicians. He is known not only as one of the ablest critics of pure music, but also as an author who is concerned with its relation with the other arts.

Mr. J. B. S. Haldane

Mr. J. B. S. Haldane's *Dædalus* and *Possible Worlds* are perhaps the most brilliant and effective reviews of what Science has done and may do. He is Sir William Dunn Reader in Biochemistry, Cambridge, Head of Genetical Department, John Innes Horticultural Institution.

R. A. Fisher

Dr. R. A. Fisher, who has lately been elected to the Royal Society because of his work on the Mathematical Theory of Statistical Methods, is head of the Statistical Department at the Agricultural Experimental Station of Rothamsted.

C. E. M. Joad

Mr. Joad is one of the younger classical scholars who has turned to philosophy. He has already published a dozen popular volumes on metaphysics, among them volumes in the World's Manual Series and in the Day and To-morrow Series.

Dr. Siegmund Freud

Dr. Freud's position in psychology to-day is comparable with Darwin's in biology in the middle of last century. One of the most significant of his methods (with which his study of Leonardo made the world familiar) is to take an artist genius, illustrate through the artist's work the subconscious forces which therein find their expression, and so reveal on this scale the common motives that underlie ordinary behaviour, which is denied this power of expression. This study of Dostoevski is an important contribution to the method.

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